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UNITED STATES TREASURY DEPARTMENT

For distinguished services rendered in behalf of the War Savings Program, this citation is awarded to

California Oil World & Petroleum Industry

Given under my hand and seal on June 12, 1943

Henry Morgenthau Jr.
SECRETARY OF THE TREASURY

In the service of our country

IN THIS ISSUE

	Page
Administrative Highlights	5
State Surveys California Tideland Oil Possibilities	7
Gun Perforating Performances	9
Importance of Consideration of Soil Mechanics Relative to Compressor Foundations and Design	13
Some Tools and Methods Used in Cleaning Oil Wells in California	21
National Supply Company—Torrance Plant—Expands for War Activities	29
Bethlehem Supply Co. Turns Out Wide Range of Production for War Industries	32
How Lufkin Has Grown	35
Precision Gauge Industry Blossoms on West Coast	45
Los Angeles Basin Developments	47
Coastal Developments	50
San Joaquin Valley Developments	52

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September 28th, 1943

Telephone Number TUcker 2571

TEXAS HURRICANE LEVELS SHELL'S 1050 FT. COOLING TOWER . . .

HERE'S THE CHRONOLOGICAL STORY OF THE BIGGEST, FASTEST COOLING TOWER REBUILDING JOB IN HISTORY!

JULY 27 – 137 m.p.h. hurricane sweeps through Houston area causing widespread damage, extent of which is unknown because communications are down.

JULY 28 – Anticipating need for immediate emergency repair service, Fluor's Houston office calls Los Angeles at 6:00 A.M., P.W.T., requesting entire Cooling Tower Division to stand by for action. Immediately, and without report of extent of damage, Fluor orders field superintendents and erection crews into area. In the afternoon, first report of damage comes in – "The 1050 ft., 175 bay Shell Oil Co., Inc., cooling tower is down; refinery off stream." 95 bays of this tower were of other manufacture, erected on special basin creating engineering as well as mill production problem. Fluor engineering department immediately goes to work. Fluor mill goes from 48 hour week to 68 hour week. Mill production goes up from normal 30,000 board feet per day to 61,000 board feet per day. To obtain necessary freight cars to express shipment, Fluor traffic department goes on 16 hour day and continues for 17 consecutive days.

JULY 29 – First Fluor superintendent arrives at scene. Cleanup and salvage starts.

JULY 30 – First 2 carloads of 56-car EXPRESS shipment of material leaves Los Angeles for Houston. Rail authorities believe this to be the LARGEST SINGLE EXPRESS shipment ever to originate from a single point in history. All Fluor crews dispatched to area are on job; work under way.

AUG. 13 – Car after car having arrived since initial shipment July 30, Fluor now has 80 bays of tower up with water on them. Refinery partially on stream. Last carload of towers expressed from Los Angeles.

AUG. 17 – *TOWER FINISHED – 175 bays, 1050 ft. of cooling tower erected with water on them in 20 days! ENTIRE REFINERY BACK ON STREAM!*

SPECIAL – In addition to the Shell job, Fluor also shipped 57 additional bays of cooling towers for other companies in the area!

A total of 1392 ft. – 232 bays – of cooling towers in 20 days in spite of the fact that, with the exception of 80 bays of the Shell tower, all were for other make towers on special basins!

Administrative Highlights •

Robert E. Allen Joins A.P.I.

The initiation of a long-range campaign to help the petroleum industry keep the American public thoroughly informed on the facts of oil was announced on Sept. 15 by William R. Boyd, Jr., President of the American Petroleum Institute. Directing this telling of the oil story will be Robert E. Allen, former Assistant Deputy Administrator of PAW, whose appointment as API Director of its Department of Information was also announced by Mr. Boyd, who in commenting on the appointment said:

"To his new duties, Bob Allen brings a wealth of experience and knowledge of the industry which he has served since his high school days in the oil fields of West Virginia. Since that time, petroleum has been both his vocation and avocation.

"Trained in the oil fields and schooled in geology and engineering at West Virginia University, Bob Allen has now completed a cycle of petroleum industry experience that peculiarly qualifies him to help the industry tell the story of oil. Since his appointment as Director of Production in the Office of Petroleum Coordinator in June, 1941, and his subsequent promotion to Assistant Deputy Administrator of PAW in January, 1942, he has been telling official Washington, Congress, and Federal and State administrative agencies that the war could be neither fought nor won without oil and that fighting oil could not be had without the vast tonnage of materials and equipment that was necessary to drill wells, build pipe lines, construct new refineries and provide essential distribution facilities.

"In pursuit of oil, Mr. Allen has travelled and worked in the principal oil states of this country and also in Australia, Canada and Mexico. He was called by Secretary Ickes and Deputy Administrator Ralph K.

R. E. "Bob" Allen

Davies from the chairmanship of the Alberta Petroleum Board of Canada, where he had been directing the development and conservation of oil and gas, to assist in the organization of OPC immediately after its inception and was the first divisional director appointed, and in January, 1942, was promoted to the post of Assistant Deputy Administrator. His Washington career is well known to the multitude of oil men whom he has assisted with their manifold problems that have arisen as a result of war shortages.

"Most of Bob Allen's recent years have been spent in California where his experience in a wide field with several oil companies and his well known advocacy of petroleum conservation led to his seven years' experience as assistant oil umpire of California and as executive secretary of the Central Committee of California Oil Producers. During this period, he served for a time as a member of the Federal Petroleum Economics Committee and later as a member of the Special Committee on Small Enterprises. His most recent service with PAW has therefore had the background of previous bits of governmental work as a consultant. Also during this period he found time to be an active member of the API Committee on Production Allocation and to make several appearances at various official hearings of the Cole Committee and others.

"Tucked away in his oil experience are five years of experience as machinist, engineer and executive in the steel industry, which has stood him in good stead in his membership on the WPB Requirements Committee and other groups dealing with the allocation and distribution of critical materials to all industries.

"At one time he served as a publicist of the National Fertilizer Association, and experience that still impels him to keep posted on current developments in crop fertilization and protection, particularly if the fertilizers, hormones and sprays are derived from petroleum.

"His main hobby, however, as well as his business, is oil. That is why he has been chosen to direct the Institute's Department of Information and why he has been taken from a tremendously important key position in government to do this job. I am deeply grateful to Secretary Ickes and Deputy Administrator Davies for consenting to release him to the Institute."

P. A. W.
Issues Directive No. 71

Pacific Coast refiners of diesel fuel oil with a cetane number specification of 40 or higher have been directed to sell this product only to the military authorities, the Petroleum Administration for War announced on Sept. 7.

Petroleum Directive No. 71 instructs all PAW District 5 (Pacific Coast States) refiners to process all petroleum distillate cuts to obtain the maximum yield of 40 cetane number or higher, and to sell same only to the military authorities, unless an exception is granted.

Administrator Ickes said:

"Military requirements for the higher grade diesel fuels must be met and this order will provide maximum local production of the needed products and reserve them for military requirements and such essential civilian requirements as cannot be met by lower cetane number diesel fuels."

The restrictions apply only to sales from future production and from stocks on hand at refineries on the effective date of the order. They do not apply to stocks which have moved out of refinery storage to points intermediate in the chain of distribution between the refinery and the ultimate consumer.

The District Director of Refining for District 5 is authorized to grant exceptions for sales of diesel fuels up to 45 cetane number. He may grant exceptions for sales of diesel fuels of 45 cetane number or higher only when:

1. The military authorities have refused to purchase the product, or
2. The fuel is to be used in an engine that cannot operate efficiently on a fuel with a lower cetane number.

Exceptions for sales of diesel fuels of 45 cetane number or higher which do not meet the above requirements, may be made only by the PAW Washington office.

Deputy Administrator Ralph K. Davies said:

"The cetane number of a diesel fuel oil is similar to the octane number of a gasoline. It indicates certain qualities and performance to be expected in diesel engines under given conditions.

"Just as our armed forces require high octane gasoline for planes and tanks, they also require high cetane diesel fuel oil, particularly for naval operations.

You Can't Afford Leaky Valves

- Repair parts are scarce
- New Valves require high priorities
- Your present Valves have to serve better-longer
- Regrinding helps make them last longer
- Note the Illustrations showing the six simple operations required

They're expensive and they may result in costly slow-downs and sometimes even shut-downs—which can't be tolerated in these critical times.

With proper care . . . periodic inspection to locate even slight leaks . . . and immediate repair, your valves will serve you better and last longer.

Lunkenheimer Valves are easy to keep in good operating condition. Seats and discs can be readily reground and all parts are quickly accessible without taking the valves out of the line. Properly cared for, they give you a practically permanent installation.

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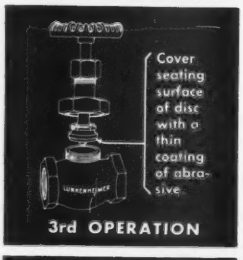
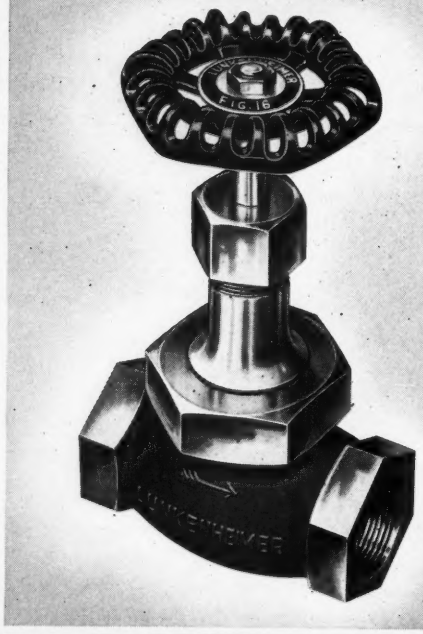
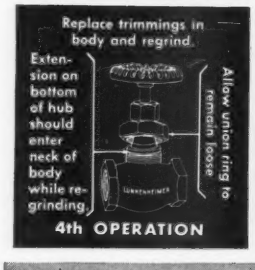
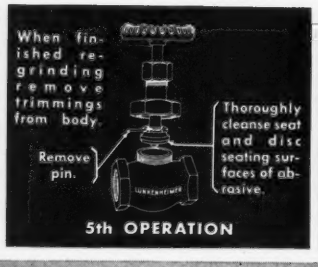





Replace trimmings in body and regrind.
Extension on bottom of hub should enter neck of body while regrinding.
Allow union ring to remain loose.
4th OPERATION


When finished regrinding remove trimmings from body.
Remove pin.
Thoroughly cleanse seat and disc seating surfaces of abrasive.
5th OPERATION

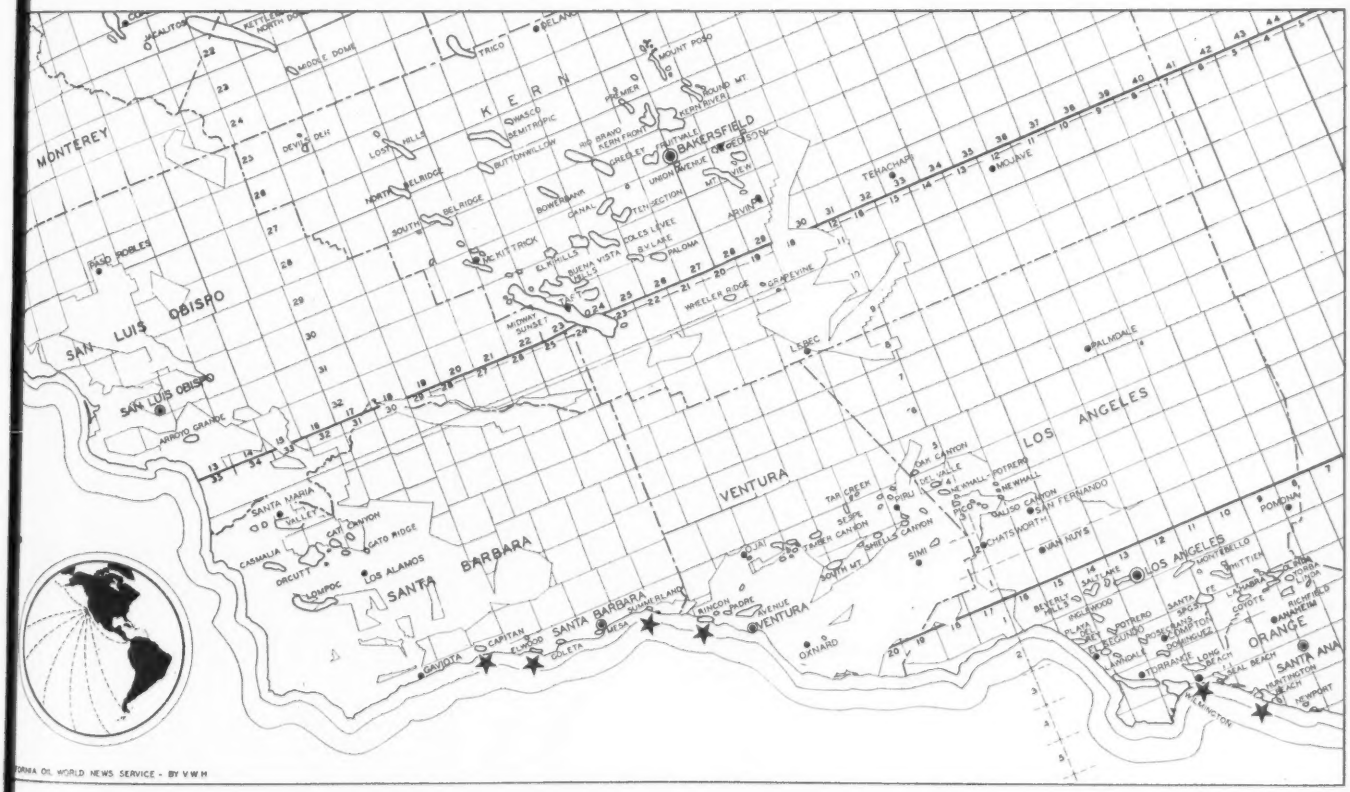
LUNKENHEIMER VALVES

State Surveys California Tideland Oil Possibilities

In the interest of furtherance of the Defense Program, and the dire need for additional crude oil production on the Pacific Coast, the State Lands Commission is having studies made of tide and submerged lands all along the coast, from San Luis Obispo County south to Orange County. In this extent of coastline, there may be a possibility of some eighteen areas having subsea oil accumulation. At nine of these areas, there already has been production obtained on the adjoining upland, and on six of them, namely, Capitan, Elwood, Rincon, Summerland, Wilmington and Huntington Beach, production is now being obtained or has been obtained from under the tidelands.

At this time, the State Lands Commission is about to advertise for bids for lease on approximately 400 acres of tide and submerged lands for the southeasterly extension of the Rincon Tideland Pool in Ventura County and on approximately 200 acres for an extension northwesterly of the Elwood Field in Santa Barbara County. In the near future, an area of tide and submerged land in Orange County, westerly from the mouth of the Santa Ana River will likewise be offered for bid for lease. All advertisements for bid for lease of State lands are published in a newspaper of wide circulation in the county wherein the area to be leased is situated.

At this time, extensions to the Elwood, Rincon and Huntington Beach Tideland Pools are being prospected on existing leases. Flowing wells of good capacity have been obtained by the Honolulu Oil Company and additional drilling is soon to be commenced by Richfield, General Petroleum and Honolulu in this field. At Huntington Beach, the Southwest Exploration Company and H. R. Hamilton are bringing in flowing wells of at least 1000 barrels potential from the Jones Tideland Zone. This zone in the early development of Huntington Beach Tideland Pool was completely passed up. Present indications are that the State's oil reserves have been increased approximately 75,000,000 barrels by the Rincon and Huntington Beach developments.



Map showing scope of California off-shore oil areas under discussion. Stars indicate where operations are already well advanced.

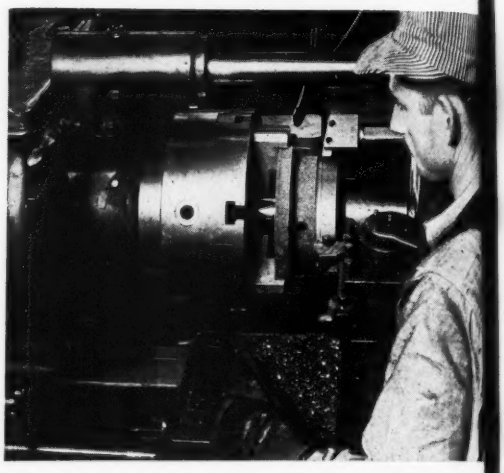
Built from the GROUND UP with our modern tools and precision equipment

Every major part in a LUFKIN Unit, except anti-friction bearings, is manufactured and assembled in LUFKIN'S modern plant from the finest materials available. Each step in the manufacturing process is under the direct control of a complete inspection department.

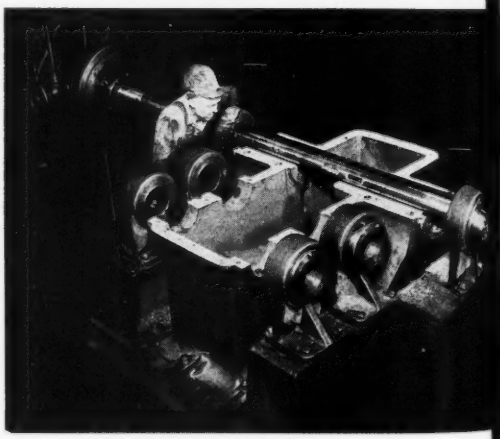
This, plus the fact that LUFKIN engineers are in close cooperation with oil industry engineers and steel industry metallurgists, makes it possible for LUFKIN to maintain standards of perfection in design and manufacturing never attained by others in the pumping equipment field.

LUFKIN accepts complete responsibility for the manufacture of each LUFKIN Unit.

Grinding for accuracy. All shafts, pinions, crank pins, etc., ground to absolute micrometer size.



The most modern type of turret lathe—one of a battery perfor ing similar operations. Note that boring, facing and turning rou and finish cuts are completed in one operation.



Without doubt the most expensive and the most accurate bar y built for precision boring of parallel bearings. This photo show cover removed, revealing entire operation of bar.

WHEN WAR CLOUDS CLEAR . . .

When war clouds clear, Lufkin will be in better shape than ever to take care of oil country needs. Every spare moment from the War effort is devoted to post-war planning. Improvements in design — new and better methods and materials—increased production—will keep Lufkin in top position in the pumping unit field.

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Gun Perforating Performances Improved by NEW BULLET DESIGN

By G. F. Turechek
Lane-Wells Company

Continuous research by Lane-Wells for improvements in gun perforating operations has perfected an entirely new bullet design. Long desired improvements in hole characteristics, straight flight through angular penetration, and other new features are discussed in this article.

Lane-Wells Company has carried on continuous research and development work on the gun perforator for nearly eleven years. The engineers and technicians engaged in this work have long known that proper design in respect to the proportion and relation of the gun elements is far more important in obtaining efficient penetration and performance than the weight or volume of powder used. A discussion on the effective use of powder to secure the best penetration and performance in gun-perforating operations will be presented in the next issue of "Tomorrow's Tools — Today." An important phase of the research studies in the laboratory and the field has been in conjunction with bullets and their effect on casing.

Regardless of the type of gun—whether a rifle, or artillery piece or an oil well perforating gun—a critical relationship exists between the bullet weight and the size and design of the gun. Within certain limits there can be variations in the weight and shape of the bullet, and the determination of these factors has been an important part of the Lane-Wells research program.

After countless experiments during the early development of bullets for gun perforators Lane-Wells adopted a conical shaped point for deep penetration. The weight of the bullet and the angle of the point finally adopted produced penetrating ability far superior to other designs and practically all gun perforator bullets have since followed that pattern.

Improved Performance in Single or Multiple Strings

Continued research has finally developed a new bullet with an ogival point which produces greatly improved results not only in penetrating ability but also in the character of the hole made in the casing. The outline shape of the ogival point is in the form of a pointed arch. This produces a thicker extreme point of greatly increased strength. No chips break off the point to deflect the course of the bullet or to affect penetration.

The improved flight stability of the new bullet has been noticeably evident in tests made through three strings of casing where the bullet's course was still straight after penetrating the outside casing. In single strings deep penetration in the formation is achieved because the bullet passes through the casing without deviation even when striking the casing angularly. As the bullet enters the formation point foremost, with practically no tendency to tumble, maximum penetration is achieved, resulting in deeper passage in the formation and consequently reducing "key stoning" effect immediately surrounding the bore hole.

Maintains Straighter Flight Through Angular Penetration

The center of gravity in the ogival bullet is forward from that in the conical point. This helps to keep the bullet traveling in a straighter path, should it strike the casing at a slight angle. Such an angle condition may exist when the gun, which is freely suspended in the well, takes a position eccentric to the casing. The greater the difference between the diameter of the gun and the inside diameter of the casing the more pronounced is the possible eccentricity.

Fig. 1 illustrates this angle condition. It shows a gun of small diameter used in a comparatively large casing. If the gun is one-half of the diameter of the inside of the casing the maximum angle between the bullet's line of flight and the casing wall occurs when the barrel is pointed at right angles to a line drawn through the center of the gun and its point of tangency with the casing. Bullets penetrating at any other point strike

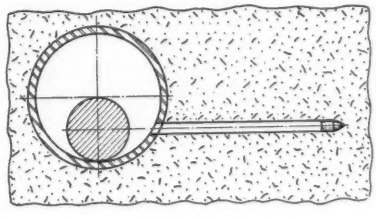


Figure 1

at less angle; likewise, larger guns reduce this angle to a lower value. Under acute angle conditions, the bullet point is subjected to rather severe lateral stresses and the strong tip of this new shape gives it a decided advantage, as does also the forward center of gravity.

In addition to the lateral stresses there are very severe compressive stresses set up in the bullet when it strikes the casing. As penetration takes place, a displacement of the casing metal in front of the bullet must occur. With the ogival bullet design, this displacement is more constant for each increment of depth of penetration. This point is illustrated in Fig. 2, which uses, for the sake of simplicity, only two increments. The volumes of the shaded portions, which represent the metal displaced in the first and last increments, are much more nearly equal than in the case of the conical point. This more constant displacement causes the compressive stresses which are imposed on the ogival point likewise to be more constant. The suddenly applied, and just as suddenly relieved, stresses that a bullet is subjected to in going through several strings of casing are always severe, so any smoothing out of these peak loads is an aid in maintaining a sound structure in the bullet point—so vital in attaining the highest degree of penetration.

Greater Penetration Achieved

The ogival shape permits a shorter bullet for the same weight. On first thought this might seem to be of little consequence, but in gun perforator work it is an item of considerable importance. As the gun is lowered to the shooting level on a freely suspended cable it will, in the majority of instances, come to rest against one side of the casing. Practically every well has a slight inclination from the vertical and the gun will, therefore, naturaly rest on the lower side. Since the gun barrels are axially spaced in the gun body, some of the barrel muzzles are apt to be pointed very near to, or directly at, the point of tangency between the gun and the casing; and the casing which is to be

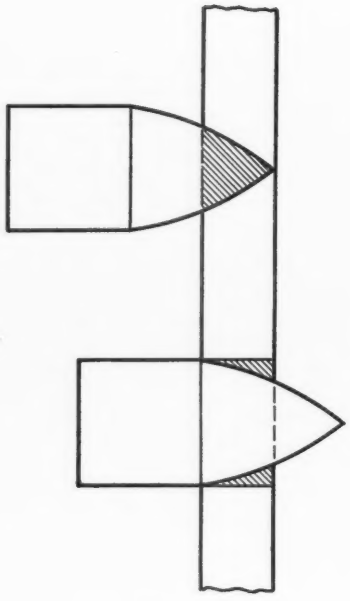


Figure 2

penetrated is therefore directly against the muzzle of the barrel. The bullet upon being fired, therefore, strikes the casing while it is still within the barrel.

Gun perforator barrels are always short, because they are limited by the diameter of the well casing. The barrel length is seldom over three times, and often not over twice, the bullet length. If the bullet encounters the casing when its base has traveled only one-half or two-thirds of the length of barrel, the powder gases have not had a chance to develop full velocity nor impart full energy to the bullet. In a former article on interior ballistics* it was pointed out that the energy imparted to a bullet is a function of the force propelling the bullet multiplied by the distance through which this force acts. The new ogival shape permits a shorter bullet without reducing its weight and thus provides a greater distance of travel when the base remains the same. This results in a longer effective barrel which gives greater velocity and, consequently, greater penetration.

Improved Hole Characteristics

The new ogival bullet has greatly improved the characteristics of the perforation made in the casing. As with the conical pointed bullets, the metal which occupied the hole in the casing made by the bullet is in the major part displaced rather than removed. The hole is round, smooth and uniform. The major change is in the character of the burr on the inside of the casing. The ogival point has a different action since it actually rolls this metal back out of its path, as illustrated by Fig. 3. In the left view the bullet is just entering the casing. The metal which forms the burr takes the path of least resistance and starts extending along the bullet point. In the central view the bullet has penetrated the casing deeper and the burr is starting to fold over as a bead, due to the curvature of the bullet point. In the right view (where the casing alone is shown) the tightly rolled bead has its outer edges rolled against the casing and there are no sharp projections which are injurious to swabs, well washer packing, or other tools of this nature. Of the many tests conducted throughout the development work associated with

*"Interior Ballistics Applied to Gun Perforator Design," by G. F. Turechek, "Tomorrow's Tools—Today!" Vol. VIII, No. 3, Third Quarter 1942.

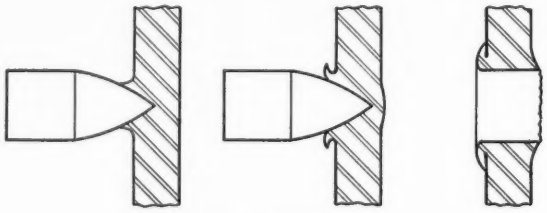
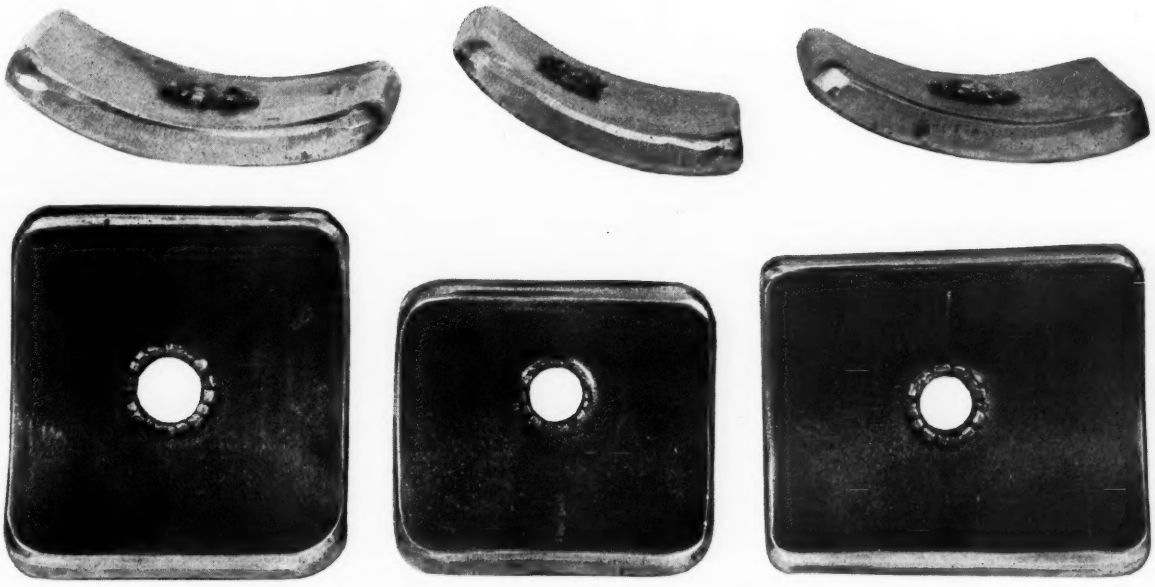


Figure 3

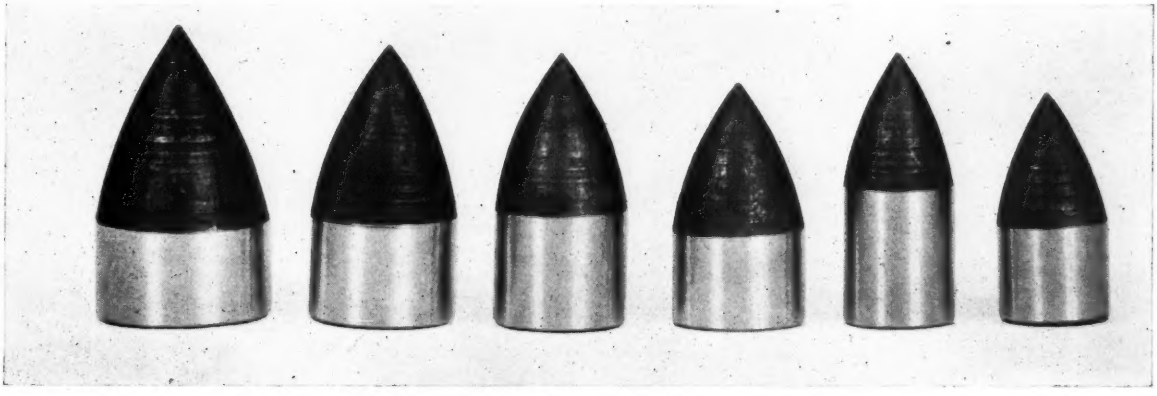


Samples of perforated J-55 Casing. The center photographs show perforation made by cone-shaped bullet. Note the tightly flattened bead made by the ogival-point bullet in the photos at the left and right.

these bullets, the smoothly rolled bead was characteristic of this new bullet and the performance was consistent in all grades of casing. Consistency was also very apparent throughout the tests in respect to the features of straight flight, point strength, and deep peneration.

As the development and experimental work progressed, trends were noted that were attributed to certain features of the bullet design. These features were tried and tested many times and with innumerable variations. They were finally combined to provide a bullet which, in itself, seems very simple but which has a strong piercing point, a center of gravity moved forward to insure straight flight, a point so proportioned as to give nearly constant displacement of the metal being pierced; a bullet whose length to weight ratio is more favorable, and one which produces a hole in the casing having a well rounded, smooth burr superior to anything achieved in former designs. No single feature is accountable for all of this improvement, but the combination of these features is responsible for considerably greater penetration and better all-around general performance.

The features of the new Ogival Bullet have been demonstrated in actual field practice since this design has been used for nearly a year in California operations. It is therefore beyond the experimental or testing stage, having proved its effectiveness in gun perforating performance in a considerable number of wells under various conditions.



Six sizes of the most widely used "Steelflow" ogival point bullets show how length has been reduced without reducing weight.

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Importance of Consideration of Soil Mechanics Relative to Compressor Foundations and Design

Paper presented by: Mr. Harry R. Marsh
of Parkhill-Wade, Los Angeles
September Meeting

This paper has been prepared with the idea of discussing the general, practical considerations that should be taken into account in the design of compressor foundations, with particular reference to different soil conditions that are commonly encountered. It is not prepared to show a mathematical determination of the solution of this particular problem, nor is the discussion to be highly technical, but is being given to point out several principles that warrant consideration in the choice of foundation design for compressors, and to review a number of installations illustrating the various serious problems confronting engineers and owners.

The basic designs involved in usual foundation requirements for machinery with reciprocating parts, such as those in a compressor, are well established. Reciprocating compressors that are in general use fall into three categories:

1. Horizontal compressors, belt driven by, generally, horizontal gas engines running at speeds approximately between 160 and 200 RPM.
2. Horizontal direct connected gas or steam engine drive compressor units, generally gas engine driven, with smaller units of 225 HP and under, operating in speeds of about 200 RPM or greater, and large units up to 1300 HP, operating between 90 and 125 RPM.
3. Some years back, engine builders came out with a design of direct connected, gas engine driven compressor units with the engine cylinders vertical in a single row, or V type in a double row with the compressor cylinders in a horizontal position on the same frame, and all connected to a common crankshaft; these now are built in sizes up to about 1000 HP. This design was also an advance, in that these machines were built for speeds of 300 RPM or faster.

The first two types of compressor units have been in use over a long period of time, and the third mentioned type of machine is now in common and widespread use.

Eccentric Forces

The eccentric forces involved in these machines are all more or less of the same character; that is, the forces involved due to the weight or mass of the reciprocating parts moving in a horizontal line also other directions are transmitted to the mass of the foundation, which theoretically should be of sufficient weight to overcome these forces. In the older design of horizontal compressor units these horizontal forces were of great magnitude and the foundations of the units for a given horsepower were quite large. In the later designs, in which the power cylinders were in the vertical or nearly vertical position, the horizontal forces were considerably reduced, as only the compressor cylinder moving parts and some eccentricity due to the revolving of the crankshaft, caused horizontal forces which the mass of the foundation had to overcome. This, in addition to higher speeds, materially reduced the foundation requirement and as a result also reduced the cost of the installation, which is very desirable.

It is not the purpose of this paper to discuss the many things that enter into the computations to ascertain the magnitude of the forces of the reciprocating parts of the compressor unit and the transmission of these forces to the foundation which are peculiar to each machine. The designer can usually secure the manufacturer's data relative to these horizontal and vertical or angular vertical forces involved for a particular machine; also the manuafcturer's recommended minimum foundation expressed in yardage of concrete and a design of foundation which fits the machine involved. The recommendations by the manufacturers on foundations for compressor units are generally predicated on soil having a bearing value of 4,000 pounds per square foot. This information as to the eccentric forces involved in the machine selected and the minimum mass of foundation required is the starting point for the engineer to consider in preparing the design of his plant.

Soil Consideration

The next step is the consideration of the soil and its mechanics, on which the plant is to be built. This is also the point where mathematical calculations become secondary and the engineer's judgment becomes so very important.

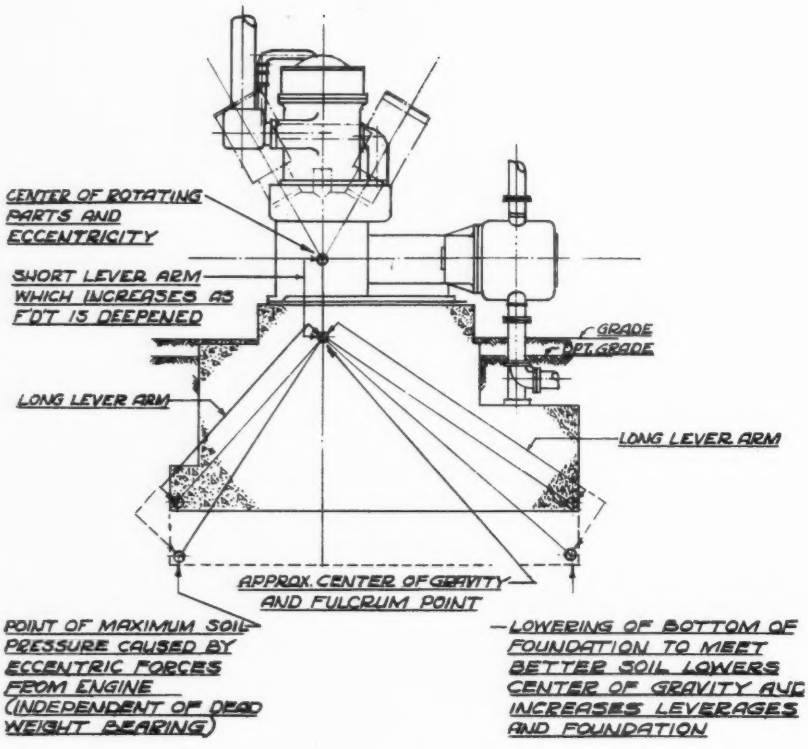
This is particularly true today, as compressor unit design has advanced, in that the machines operate at high speeds, that is, 300 to 350 RPM or faster, and a great deal more work is done with a relatively lighter weight of machinery. This also results in smaller foundations per horsepower unit of the compressor. Incidentally, at these speeds, whenever the number of times of change in direction of movement of the reciprocating parts of the compressor reach a point of vibration approaching that equal to vibration causing sound, these vibrations are transmitted to the soil with peculiar results and, in some cases, with serious consequences.

As no doubt manufacturers are looking forward to the design of compressors of high speeds for this type of machinery, scientific research should be carried out and further studies made regarding this new development with relation to the problem of compressor plant design. Such investigation should be conducted, probably by some representative group of the oil industry's engineering associations and the manufacturers of compressors, collaborating with technical institutions.

The selection of site for a plant invariably involves many other considerations besides the best soil condition, such as the location of the field, or the route of a pipeline, the location of the plant as nearly as possible on ground that is not subject to flood, and many other considerations too numerous to mention.

Engineer's Problem

It is the engineer's problem, there-


CENTER OF ROTATING PARTS AND ECCENTRICITY
SHORT LEVER ARM WHICH INCREASES AS F'DT IS DEEPENED
GRADE
PT. GRADE
LONG LEVER ARM
LONG LEVER ARM
APPROX. CENTER OF GRAVITY AND FULCRUM POINT
POINT OF MAXIMUM SOIL PRESSURE CAUSED BY ECCENTRIC FORCES FROM ENGINE (INDEPENDENT OF DEAD WEIGHT BEARING)
LOWERING OF BOTTOM OF FOUNDATION TO MEET BETTER SOIL LOWERS CENTER OF GRAVITY AND INCREASES LEVERAGES AND FOUNDATION

TYPICAL COMPRESSOR & F'D'T.

FIGURE 1

fore, to design a foundation to meet the soil condition that is found on the site. The engineer generally has some excavations made, and if not too much is already known of the locality, bearing tests are made on the soil at the level he believes will be best suited to the plant design.

If the bearing tests show that the soil does not yield with a reasonable loading, the weigh of the engine compressor unit and the foundation are added and the bearing per square foot is computed and the foundation spread to meet the load that his tests indicate the soil will withstand. The engineer generally allows a safe margin between the point of failure of the soil which his tests indicate and that which he will impose on the soil with the new machinery.

In some cases the owner and engineer have been forced to go into locations that were extremely doubtful in respect to the value of the soil to support the machinery. In those cases, special consulting engineers are generally called in, who make cored borings, soil bearing tests, report their findings, and make recommendations as to the maximum loads that should be imposed upon the site. Again the engineer exercises his judgment and usually allows a safe margin between the reported bearing value of the soil and that which he imposes on it with the compressor machinery.

Foundation Design Principles

Now, we wish to present several simple principles involved in compressor foundation design that we believe are of interest. This discussion will deal with the vertical engine, horizontal compressor cylinder, direct connected type units.

In Figure 1, the center of gravity of the mass of the compressor and its foundation is in the upper third of the concrete foundation. The center of the crankshaft and compressor cylinder around which the eccentric forces operate, and the center of gravity, are fairly close together. As a foundation is deepened, which is in some cases done to meet a strata of soil of better bearing value, the center of gravity lowers and the distance between the center of the crank and the center of the gravity increases. This increases the lever arm, and thus also increases the forces transmitted to the soil at the tow of the foundation, as indicated in the diagram. These forces sometimes exceed the margin of safety allowed by the engineer between those calculated and the bearing tests indicated. This generally results in the compressor and foundation getting in a rocking motion, which is detrimental to both plant structures and piping.

In Figure 2, another consideration of design of compressor foundations is shown. This is a spread foundation as shallow as possible and as piping will allow. In some cases this spread footing is under the compressors only, and where several compressor units are involved, all are connected together. The spread footing actually being a reinforced concrete mat, generally reinforced top and bottom to take care of negative moments in the concrete slab that might result from uneven soil reaction, and on this mat the concrete, which forms a pad on which to set the compressor, is poured. This design accomplishes two purposes; spreads the foundation and materially reduces the soil bearing requirement, and prevents the lowering of the center of gravity of the machine and its foundation, and lengthens the arm between the center of gravity and the tow of the compressor foundation, thus reducing the soil reaction necessary at the tow of the foundation.

In later designs, the spread footing has been in some cases extended beyond the building wall limits of the plant, and the building walls and building also rest on the concrete mat. This increases the mass of the compressor foundation as the weight of the floors, backfill under the floors, building walls and building become an integral part of the foundation. It is interesting to note that in some cases, with these weights added onto the mat, the installation of 600 HP machines resulted in soil bearing under the mat of the whole plant of less than 1500 pounds per square foot of bearing surface and, in cases of 300 HP units, of less than 1000 pounds per square foot. This definitely allowed these plants to be set on extremely poor soil and yet result in satisfactory operation without any difficulty from compressor unit vibration.

The above discussion and the illus-

trations are, we believe, sufficient to lead us to the conclusion that shallow and spread foundations, almost regardless of the nature of the soil underlying the plant, except on rock formations, are to be recommended.

Cost Comparison

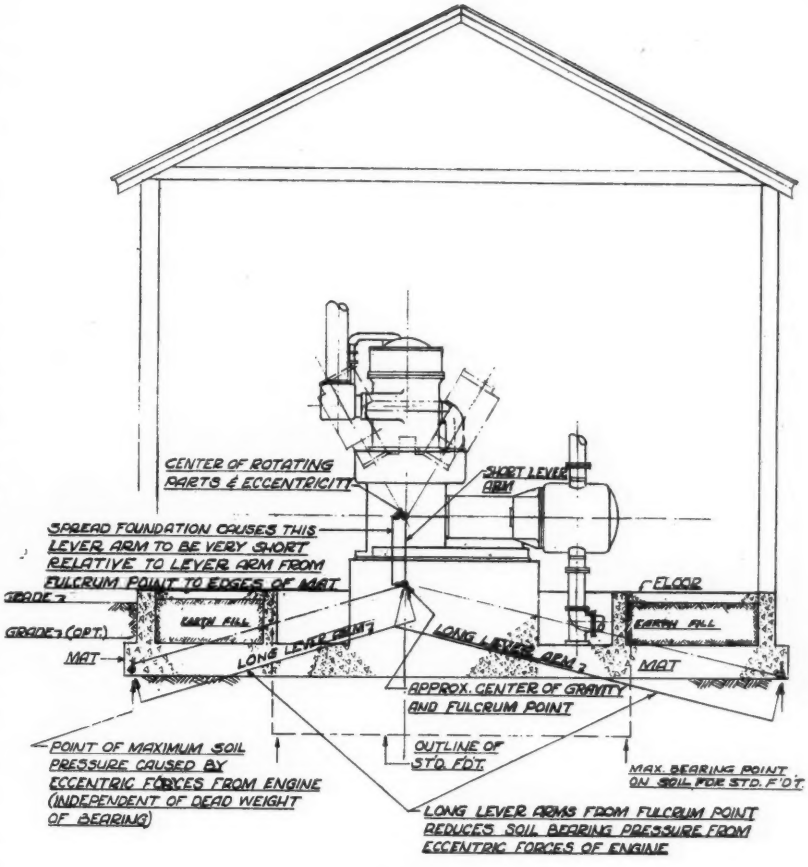
At this point the question of a comparison of costs is in order. In cases in which the spread foundation has been used and a mat construction installed, the increase in yardage of concrete for the compressor foundation, building foundation and walls, piping trenches, and building floors is less than would be supposed. Comparisons have been made in this respect and it has been found that the increase in yardage of concrete usually does not exceed 15% additional concrete over the conventional design in which the machine foundation, building foundation and pipe trenches are independent of each other.

It is interesting to point out that in some cases in which mat construction has been used, the bottom of the mat that formed the foundation for the plant is at a lesser depth than that called for on the manufacturer's standard recommended foundation drawings. Also, it is interesting to note that these concrete mats were not of great thickness; in cases of large units of 600 to 1000 HP being 15 to 18 inches in thickness, and on smaller 300 HP units being 12 to 15 inches in thickness. These mats thicknesses were determined using the standard methods involved in concrete design and keeping within the limits of concrete and reinforcing steel maximum allowable stresses.

As the cost of an additional 10 to 15 per cent of concrete is less than approximately 35c per horsepower of compressor capacity, this is a comparatively insignificant addition to the plant investment cost, and it is worth such small additional cost to reasonably insure a plant that will be free from serious difficulty resulting from inadequate foundation design.

Soil Investigation Determining Factor

In determining compressor foundation design, soil investigation should be thorough and should include investigation for some distance around the plant site. This is particularly so in cases which investigation reveals that clay beds exist at levees satisfactory upon which to place the plant foundations.


CENTER OF ROTATING PARTS & ECCENTRICITY
SHORT LEVER ARM
SPREAD FOUNDATION CAUSES THIS LEVER ARM TO BE VERY SHORT RELATIVE TO LEVER ARM FROM FULCRUM POINT TO EDGES OF MAT
GRADE
GRADE (OPT.)
MAT
EARTH FILL
LONG LEVER ARM
FLOOR
EARTH FILL
LONG LEVER ARM
MAT
APPROX. CENTER OF GRAVITY AND FULCRUM POINT
POINT OF MAXIMUM SOIL PRESSURE CAUSED BY ECCENTRIC FORCES FROM ENGINE (INDEPENDENT OF DEAD WEIGHT OF BEARING)
OUTLINE OF STD. FDT.
MAX. BEARING POINT ON SOIL FOR STD. F'DT.
LONG LEVER ARMS FROM FULCRUM POINT REDUCES SOIL BEARING PRESSURE FROM ECCENTRIC FORCES OF ENGINE

COMPRESSOR ON MAT FDT.

FIGURE 2

This recommendation is particularly true where the plant sites are located in valleys over which a stream has varied its course in its geological history as in these cases, many times, the clay beds are under and sometimes overlaid with sand, gravel, or a conglomerate, and the clay is an alluvial deposit. In these cases the clay beds are sometimes tongues or spits of clay deposited by the stream's action in changing its course, and vary in thickness.

Compressor foundations placed upon this type of clay soil will transmit vibrations through the spit of clay to any other foundation that may rest on this same clay bed. This results in disturbing the other structures.

It is also known that plants which rest on clay soil that is of reasonable thickness and uniform for long distances around the plant, have transmitted vibration to other structures in the same manner. Means of overcoming this difficulty are at this time, insofar as the author knows, undeveloped.

Batter Pile Usage

In swamp locations, or tideland locations, engineers have commonly resorted to the use of piling to support compressor foundations. Here again the mat construction has proved its superior worth over piling-supported, conventional individual type foundation design. Where it is necessary to resort to piling construction, it is imperative that batter pile construction be used; that is, a number of piles driven at an angle transverse of the center line of the crankshaft of the machines to stabilize or brace the piles that are carrying the load.

As shown in **Figure 3**, the batter piles are in effect diagonal braces for the piles that support the weight of the plant. The material through which the piles are driven not only lack the ability to support the vertical load but also any horizontal load, thus in effect the compressor plant is on stilts, so to speak, as the piles are driven until the lower end or tips

begin to engage material of sufficient solidity to support the loads imposed upon them. Without the batter piles acting as lateral bracing to transmit the horizontal forces to the strata that supports the plant, the whole sub-structure of the plant lacks stability. Plants that have been installed on piles without this lateral bracing or batter piling have, almost without exception, been extremely dangerous and troublesome to their owners and the engineers.

Rock Beds

The installation of compressor plants on sites which are provided with rock formation as a bed for the compressor foundations are, we believe, relatively scarce. In those cases with which the author is familiar, the concrete foundations of reinforced concrete and anchor bolts have always been designed to be sufficient to insure a monolithic foundation for each machine securely embedded in and grouted to the rock. As this is a most desirable condition, presenting the fewest problems, further discussion of it is unnecessary.

Water Inclusion of Sand Beds

In some cases, compressor plant sites have been located on sand, or sand and gravel beds. In these cases the conventional bearing test generally reveals that the soil has fairly high bearing value, often from 4,000 to 10,000 pounds per square foot of bearing surface, thereby leading the engineer to believe the plant design problem to be relatively simple. Here the engineer should be particularly careful not to conclude his investigation, but should ascertain the level of the surface water, if any, take into consideration the rainfall of the area, and seek to determine if at any time the ground water reaches a level at or above the bottom of the plant foundations. This is particularly true in case his investigation showed that the plant was to be situated over a deposit of sand, as the inclusion of water in a sand bed will seriously change the nature of the stability of the soil to withstand horizontal forces, and in some cases also the bearing value.

A number of compressor plants that have been built in the usual manner with compressor foundations independent of each other and of building structures, placed on sand or sand and gravel locations, have been observed by the author and in some of these cases where the ground water rose to or above the bottom of the foundations, these compressor plants have been troubled with horizontal movement that was detrimental to the buildings and dangerous to the operation of the plant, due to the unforeseen stresses that developed in the piping connecting the compressors to the pipeline or other equipment of the plant installation. Whereas plants that have been designed using the spread or mat type construction located on sand or sand and gravel beds have not developed this difficulty.

In some areas of the San Joaquin Valley, soil is found with soluble salts throughout it and upon becoming continually wetted has a tendency to dissolve and shrink, thus lowering the surface and, if water comes under foundations, to cause them to drop. Plants located in this type of soil should have drainage carefully provided so that ground water can be drained to prevent its getting under the foundations, and the surface surrounding the plant should be paved to turn water so that water from rains and operations will run off and not be allowed to seep to and under the plant foundations.

Typical Plant Installations

As a matter of interest and illustrate further the importance of the consideration of soil mechanics relative to the design of compressor plant foundations, we will briefly outline a number of compressor plant installations that are particularly interesting and illustrate the discussion of this subject.

In 1930 one of the large interstate gas transmission lines was built. In the first stations 1000 HP twin tandem, double acting gas engine, direct connected compressor units were selected to pump the gas through the pipeline.

Kansas Plant

The first station of this line was located in western Kansas on a site underlaid with sand, and the first installation involved five such units. The overall dimensions of each compressor unit foundation were 52′ long by 21′ wide, and all foundations for the five units were placed upon a 2′ thick mat which was several feet wider than the compressor foundations were long, with building foundation separate from the compressor units. The basement floor between the units was the top of the mat and basement floors were poured and extended from the ends of the compressor units to the building foundation. The operating floor was concrete supported on steel beams, which in turn were supported by the compressor foundation and the building walls and foundations. This construction proved satisfactory, and in this particular plant no trouble developed from this selection of compressor plant foundation design.

Missouri Plant

Another compressor plant on this pipeline was located in west-central Missouri on a site underlaid with solid rock. At this plant the foundation situation was ideal, the main construction job being the blasting and cutting away of the rock to the proper level to allow for the full basement design that was used in these plants.

These plants have been added to since, over a period of some years, using the same construction, and both have operated satisfactorily.

Louisiana Problem

Another gas pipeline system extending from Louisiana up the Mississippi River Valley, with the original compressor plants built in 1927, are interesting. These plants were constructed, using the design of individual foundations for each horizontal 1000 HP compressor unit, and the units independent of the building foundations. These also afford interesting observation.

These compressor plant sites were located in and near swampy territory and on very poor soil, made up mainly of sand with thin layers of clay, and with ground water within a few feet of the surface. Consequently, the engineers chose piling driven about 20 to 25 feet to a strata of firm clay or soil. When these plants were started there was some horizontal movement of the machines and their bases which was not serious. The operator also slightly staggered the speeds of these machines to prevent their getting "in step," and thus reduced the magnitude of the horizontal movement.

These plants operated over a period of about ten years, at which time additional compressor facilities were necessary for this pipeline. Up to this time the small horizontal movement of the machines and their foundations on the piling had not been serious enough to cause any damage to the plant or to cause undue alarm. However, this move-

ment was transmitted to the piping, which was buried underground and connected to atmospheric type gas coolers located in the cooling towers. An observer, standing on the top of the tower, could easily feel a sway in the cooling tower, which was in rhythm with the speed of the engines. In one of these plants two additional vertical gas engine horizontal compressor cylinder, angle type compressor units were installed on a concrete mat in turn supported by piles, the rotation of these additional units being transverse to that of the horizontal 1000 HP units. This tended to stabilize the whole compressor plant in a rather peculiar fashion. The end of the compressor building in which were located the angle type machines was practically free of any horizontal movement, but the horizontal movement of the plant was progressively greater toward the other end of the building which contained the four 1000 HP compressor units. Since the installation of the first two angle type machines, additional angle type machines have been added to the plant, and the horizontal units, through an expensive construction operation, have been placed upon a common concrete mat.

Flood Conditions

In 1937 on this same pipeline, the first large size angle type compressor units were installed. This consisted of five 600 HP compressor units. The plant size was in a particularly swampy area about 20 miles from the Mississippi River which, before flood control had been effected, would seasonly be under six or seven feet of water. Soil investigation of this site revealed that it was a sand and clay river deposited alluvial soil, with very poor bearing value. In this particular area investigation revealed that buildings and bridges were universally set on 20 to 25′ piling, which developed a bearing value of about 15 tons. The engineers who started the project decided upon mat construction consisting of a thin mat 15″ thick, reinforced top and bottom, placed approximately 1-½′ below the existing grade, on 20′ piling about 5′ centers, with the floor of the compressor plant 2′ above the grade; this to place the operating floor above the highest water level that was anticipated during flood stages and to allow the piping to and from the compressor cylinders to come out through trenches which were below the floor yet above the compressor mat. The data from the manufacturer of these units revealed that the horizontal forces of these particular machines were extremely small and, with the building, building walls, trench walls, floor and backfill between the top of the mat and the floor, provided a mass that was far in excess of that necessary to absorb the forces created by the movement of the reciprocating parts of the machines. This plant was located on a 10-acre site on which were situated five dwellings. No vibration of even the slightest degree was noticeable near the compressor plant, nor at any point on the 10-acre site.

Vibration Noted

An interesting feature of this plant was the installation of a 200 Kilowatt multi-cylinder gas engine driven electric generator unit, operating at a speed of 412 RPM, which was standby to electric services furnished to the plant by an outside power company. This unit was placed on a foundation built exactly in accordance with the manufacturer's drawings and placed on six vertical piles, which was more than sufficient to take the load imposed upon them. At any time that this generator unit was started it set up a vibration that could easily be felt in any part of the plant and as far away as the houses on the 10-acre site. It was believed that if this installation had been set on six piles driven at an angle, such as batter piles are, this condition may not have existed.

Re-Work Costly

In Mississippi on this same line, another plant was constructed using the conventional horizontal 1000 HP compressor units. Preliminary investigation, done through the summer months, showed that this plant was located over a deep sand bed and engineers in charge of the project decided upon piling to support this plant, in which each foundation was individual. In order to illustrate the compactness of this sand bed, we will remark that the piling had to be steel tipped and the butts steel ringed in order to withstand the stress that was placed on them in driving them through the sand, and a great deal of difficulty was experienced in the work of driving the piles. In the fall, when this plant was ready for operation, the ground water had risen considerably and when the plant was started the horizontal movement was so great that the plant was not safe to operate due to the stresses imposed upon the piping and the building movement, which was so great that bolts in the building framing were broken and sheared. This difficulty was overcome after a good deal of lost time in the operation of the plant and great expense involved by excavating under the compressor foundations, installing steel diagonal bracing on the piling, and refilling the burrow or cavity under the units by concrete being pumped into it.

Texas Application Successful

In 1938 two small compressor plants for high pressure recycling operations were built in the rice flats between Beaumont, Texas, and the Gulf of Mexico. These sites were 4 feet above sea level and soil tests and the experience of the oil companies in that location indicated a serious foundation problem for these plants. In this locality it was the practice to place oil well derricks on wooden mats made of 3″ x 8″ x 20′ long timbers laid in transverse layers forming a mat 20′ square under each derrick leg. In the wet season the whole area was virtually under water and the top soil consisted of a very sticky muck; in the dry season ground water was within 18″ of the surface. The placing of piling was extremely costly as 65′ piles developed extremely low bearing value. After considerable investigation it was decided to design these plants using the mat type construction. Calculations indicated that the dead weight bearing of the building, backfill under floors, and floors which were to be 2 feet above grade, and the compressor unit would impose a load calculated to be 854 pounds per square foot of bearing surface under the mat. After careful consideration this design was adopted. The compressor units were 300 HP size and had considerable horizontal forces involved. On the completion of these plants and the starting up of the units, this selection of foundation design proved to be very successful.

Urban Problem

In 1940 a compressor plant consisting of 300 HP angle type units were installed within a mile of the Delaware River in a refinery that bordered a city; in fact dwellings were located much less than a city block from the compressor plant site. As considerable refinery apparatus

had been successfully installed adjacent to the proposed compressor plant site, soil investigation for it consisted of excavating to the required depth, ascertaining that there was a compact clay deposit greater than 6 feet thick under the proposed foundation, and that the bearing value was in excess of 4,000 pounds per square foot. A compressor mat was designed to support all the compressor units and their foundations and, using this design, the installation was completed. On starting this plant, vibration developed that was transmitted through the clay beds to those structures that rested on it and over it.

Another plant was subsequently built, having four similar 300 HP units, in which the total weight of engines plus foundations equalled 750,000 pounds, and was carried on coil springs using flexible joints between the moving mass and the earth.

The experience gained from these plants and from additional studies of the sub-surface soil formation at this location has led the engineers to select piling to bedrock plus batter piles as the best solution for this problem in this particular area. At this time two plants, one of 1625 HP and the other of 2400 HP, are now under construction using the method of piling to bedrock plus batter piles to support them and give the plants stability.

San Joaquin Valley Installation

In 1942 a plant was designed and built at a location in the San Joaquin Valley which was very near a small river and located on more or less swampy alluvial soil. Special consulting engineers were engaged, who made their investigation by core borings and bearing tests, and recommended that foundations be either carried on piles, or where not on piles, that the loads imposed on the soil be not greater than 1200 pounds per square foot of bearing surface. In this case the engineers decided to use the mat type spread foundation design in view of the nature of the soil, and to forego using any piling to support the compressor plant, including its cooling tower installation. Practically no excavation was made at all, only that sufficient to scrape off windblown soil and present a level surface on which to pour the mats, and a fill two feet in depth was made over the original grade to bring the operating level near that of the floor of the compressor building. The building was of reinforced concrete and brick, with steel truss and corrugated asbestos covered roof, which is heavier than the usual type construction. This, together with the compressors, were all supported by the mat. When the backfill was completed and all the work done, the surface of the yard was carefully graded to drain and macadam surfaced so that all water would run off the site. On completion of this construction work the plant was started and this foundation design in this plant has proved to be very successful.

Non-Porus Clay As Base

A large new gas cycling plant has just been completed in Texas, in the Gulf plains near the city of Houston. The location is very flat and surrounded by rice fields, which primarily account for a water saturated soil four to five months of the year. Natural rainfall accounts for a semi-saturated condition the remainder of each year. The top soil is black sandy loam, then a layer of very fine sand which resembles quicksand, and under that a very dense non-porous clay, which is believed to be quite extensive in the area. It is on this non-porous clay that the engineers decided to place the compressor foundation mat. The compressor mat is 32′ wide by 196′ long. The maximum thickness of the mat is 20″ and tapers to 8″ thick, with a 12″ retainer curb extending the complete length of each side of the mat, with the main reinforcing in the bottom and some reinforcing in the top of the mat. There are seven angle type gas engine units of the V-engine type installed in this plant.

When this plant was started some vibration resulted. However, the compressors are extremely stable and as the piping supports are integral with the compressor mat, the problem of the vibration is believed to be negligible.

All of the equipment of the cycling plant is also based on this same clay strata, and some vibration is transmitted to these equipment and structures, but is not of serious proportion. Again, in this case, we find that clay has the characteristic of transmitting vibration considerable distances.

Novel Isolation Methods

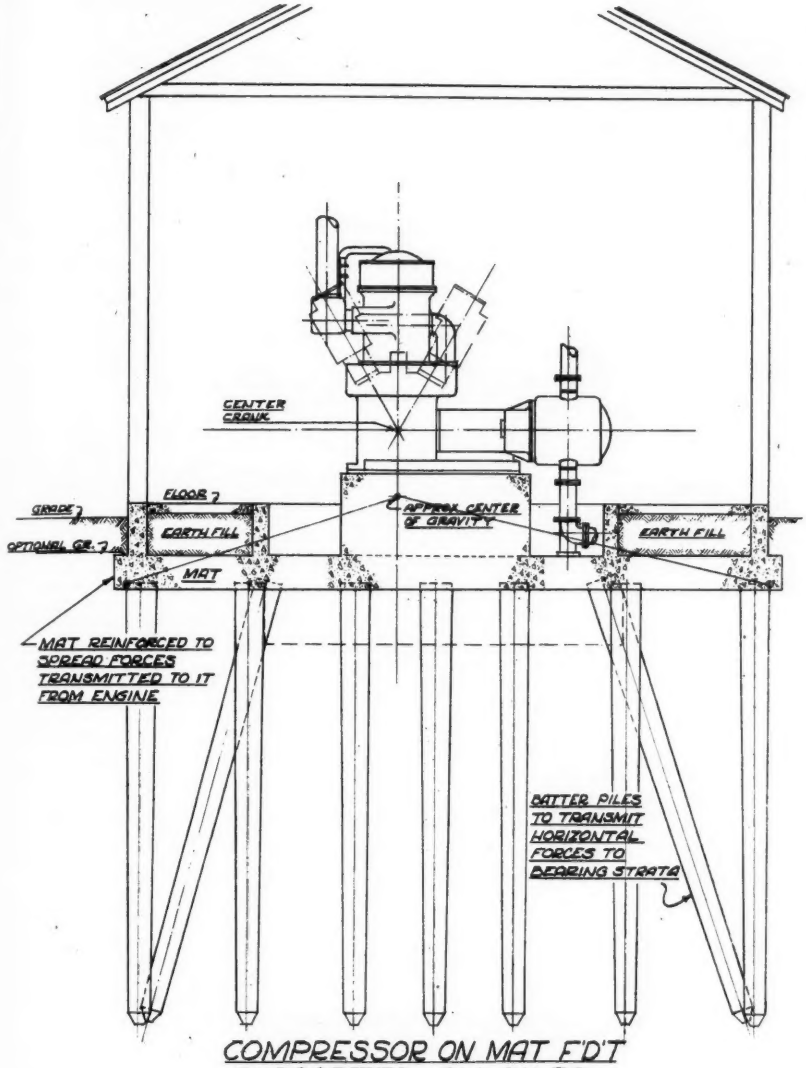
Other interesting and somewhat novel methods have been tried to isolate compressor units and their foundations from the compressor mat or substructure and thus prevent the transmission of vibrations. One novel method tried being the use of felt, but in these cases the movements of the machines were so great that it was impossible to keep flexible piping joints in service continuously; also evidence of eventual complete deterioration of the felt was discovered, which discouraged the engineers conducting this test from continuing this line of investigation.

Engine Synchronization

Another partially successful method of reducing vibration from compressors is the work of control of speed of the engines by synchronizing the machines in such a manner that they do not get "into step." However, in this investigation, the instruments used were experimental and constructed of materials which failed to stand up in continuous operation, and the engineers were justified in not going further into this development or to replace the instruments with better ones because of wartime conditions. It may be that at some later date this work can be resumed.

Lined Box Method

Another method used to dampen compressor machinery vibration has been used in a refinery located on tideland, in which all of the plant, except the compressors proper, were placed upon piling. In this case a spread footing was designed which was box type to receive the compressor foundation, the box being of a size equal to the minimum mass of concrete recommended by the compressor manufacturer. In this case the box sidewalls were lined with 1″ of cork board, and on the bottom several boards of cork 1-½″ thick by 12″ wide were laid in accordance with the recommendation of the manufacturer of the cork, whose recommendations were made taking into consideration the weight of the machine and the anticipated vibration from it. Over these boards were placed ¼″ thick steel plate strips the same width as the cork strips, and on that corrugated iron was placed to act as a form on which to pour the concrete foundation within the four walls of the box. This installation was operated over a period of several years and proved to be satisfactory. Further observation of this unit over a longer pe-



COMPRESSOR ON MAT F'D'T SUPPORTED BY PILES

FIGURE 3

riod of time is necessary to show that this method of dampening the vibrations will be successful during the life of the plant. However, all indications are that it should be successful. This conclusion is further confirmed by the fact that cork board in confined steel pans successfully dampens vibration of reciprocating machinery in buildings of reinforced concrete design. This type of installation has been successfully used over a long period of time and indicates that cork board retains its resilience over a long enough period of time to warrant its use in this manner.

Piping Vibration

Another compressor plant problem which is extremely serious, particularly in high pressure plants, is the vibration of piping, and while this paper is not prepared or meant to bear on that subject, it is worth some comment here. Piping vibration that has been of serious proportion in high pressure plants is related to the reciprocating action of the compressor in that the reciprocating piston in the compressor cylinder and the passage of the gases intermittently through the valves causes a pulsating flow and resulting pressure waves of the gas in the piping. Because these gases are dense and particularly heavy they cause a "hammer" action, thus causing the pipe to vibrate. We believe it is unrelated to vibrations set up by the reciprocating action of the moving parts of the engine and the compressor which forces are transmitted to the compressor foundation, except that they both originate from the same primary sources and are parallel in their rhythm or timing.

Conclusion

In conclusion it is apparent that for each installation the design of compressor foundations and their relation to the mechanics and reactions of the soil on which each plant is to be built present individual and interesting problems, and that the solution for each necessarily must take into consideration many factors. It has been the purpose of this paper to acquaint the engineer with as many aspects of the requirements in his selection of a foundation design for a compressor plant as possible, so that all the factors relative to soil mechanics are included in his investigation and his solution of the problem before the final foundation design of a plant is selected.

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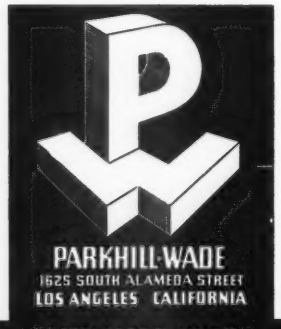

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Some Tools and Methods Used in Cleaning Oil Wells in California

By G. B. Shea

(Continued from 1st Sept. Issue)

Mechanical Perforation Cleaners Cleaning Perforations with Explosive Cord

The use of an explosive cord for cleaning perforations[13] was introduced in California early in 1941 by Ford Alexander, giving operators another "tool" that has proved its merits in numerous applications. The Merical cord perforation cleaner is a fuse containing a special, high-velocity, low-volume explosive that is hung opposite clogged perforations of a liner and denoted. Having a diameter less than that of a lead pencil and being flexible, the fuse is handled easily and can be run over small pulleys at the wellhead. With the aid of a weight attached to its lower end, the cord is lowered into the well on an insulated electrical cable. The charge is exploded by a small cap detonated from the derrrick floor by electricity.

The effectiveness of the explosive method in causing deposited cement, mud, paraffin, silt, etc., to be blown from the perforations is attributed to the high speed of detonation (23,000 feet per second), which generates a sharp jarring action. As the quantity of explosive per linear foot of cord is small, the force of the explosion is not sufficient to damage the casing or liner, although care must be taken to use the cord properly. Best results have been obtained in wells where the fluid column completely covered the explosive cord. Because of the great speed of denotation, the pressure induced by the explosion cannot be dissipated through open perforations rapidly enough to relieve the pressure on the clogged or partly clogged perforations. Thus the full force of the explosion is applied to all perforations, whether open, partly clogged, or closed.

Usually in wells equipped with 5½ to 8⅝ inch-diameter liners two cords suspended side by side are detonated simultaneously. In smaller-diameter liners and in old wells where liners are apt to be corroded and not up to standard in strength, only one cord should be used. Also, it is advisable to use only one cord in wells subject to sand trouble, even though the casing is of large diameter. Other conditions that determine the number of cords to use are the size of slots or perforations to be cleaned, the number of slots or perforations per unit area of liner, and whether the liner is welded or seamless pipe. In cleaning multiple-zone wells having two or more perforated zones, a single cord is hung opposite all zones, and additional cords usually are attached to the single cord so that two cords are opposite the perforated sections. Explosion of the single cord in the blank sections of the liner does not affect the pipe. Experience has shown that when the distance between zones is greater than 100 feet, it is not economical to clean more than one zone at a time.

To meet varying well conditions of depth, pressure, and temperature three types of cord—No. 1—Plain, No. 2—Reinforced, and No. 3—Wirebound — having tensile strength of 113, 160, and 250 pounds per square inch respectively are provided. The limit of cord length is approximately 500 feet. All three cords have equal explosion force.

B & B Liner Cleaner

The B & B liner cleaner—a mechanical device for cleaning vertically slotted liners—was introduced recently in California. The thin, spring-steel blades of the cleaner are spaced spirally around the body of the tool and are in contact with coil springs, which exert considerable thrust pressure against the blade cam (see fig. 6). The blades are free to move up and down and can retract directly into the body of the tool. The cleaner is lowered to the bottom of the liner either on a sand line or tubing and then moved progressively upward in short, slow, up-and-down strokes. As the blades come into alinement with the slots in the liner they are forced through the slots, penetrating 1 to 1½ inches beyond the outside diameter of the liner. The spirally placed blades cause the tool to rotate slowly as it is moved up and down in the well. A swivel head at the top of the tool prevents any twisting in the sand line. After the tool has reached the top of the liner, the cleaning usually is repeated for good measure. About 25 feet of liner can be cleaned per hour.

General practice is either to run a safety "double-bypass" swab on top of the cleaner or run a swab after the tool has been run to create a supplementary washing action that aids in cleaning the slots. In either case the cleaner and swab should be run until no more sand runs into the hole, because experience has shown that in most wells sand coming into the hole through the cleaned slots in the liner results in a subsequent increase in oil production. Jars usually are run above the swab as a safety precaution to assure removal of the tool from the hole should it become stuck in the liner. After the perforations are cleaned a hydraulic suction-type bailer or a sand pump is run to clean the hole to bottom.

The tool is made in two sizes—the small size to clean liners 4¾ to 5¾ inches in diameter, inclusive, and the large size to clean liners 6⅝ inches in diameter and larger. Liners as large as 11¾ inches in diameter have been cleaned successfully with the large tool.

In addition to removing sand, mud, water scale, and corrosive ma-

terial from liner perforations, effective results have been obtained in cleaning gravel packs with the B & B liner cleaner. It has been used successfully also in reopening perforations after squeeze cementing in multiple-zone completions. Frequently in squeeze cementing to isolate producing zones some cement will migrate along the outside of the pipe and into the perforations opposite these zones. After the bridge plug or baffle plate and any cement left in the pipe are drilled out, the tool is run to gouge out the cement left in the perforations and to penetrate through any cement sheath around the outside of the pipe.

Chemical Removal of Carbonate Scale

Chemical treatment to remove depositions of water scale from liners and sand faces and to reopen gun-shot perforations through cement walls surrounding well casing is now an important part of well-cleaning practice in California. The development of inhibited hydrochloric acid[14] and penetrating or wetting agents has been a boon to operators troubled with the deposition of carbonate scale in wells that produce quantities of water with the oil. Morris[15] and Maness[16] in 1938 discussed the removal of carbonate scale found in oil wells in California. Normally in scale-removal treatments an aqueous solution of 10 to 15 per cent hydrogen chloride (hydrochloric acid) by weight is used. Acid of that strength is preferable to stronger concentrations, as the viscosity of the acid sludge is a minimum; more concentrated acid increases precipitation of calcium chloride, increasing the viscosity of the spent acid. It is most desirable that the viscosity of the spent acid be low, as there is always the possibility that the solution may enter the formation during or after the treatment and create a barrier to the flow of oil to the well.

Most scale deposits in wells are formed in the presence of oil and are oil-soaked, making it necessary to add penetrating or wetting agents to the inhibited hydrochloric acid to facilitate penetration of the acid into the scale and prevent the acid from forming emulsion or sludge with the oil. Tests of oils produced in all California fields show that only those of very high gravity produce appreciable quantities of sludge when in contact with hydrochloric acid.

In certain California fields laminated deposits of carbonate scale and wax are formed, and where deposits of this type occur a special wax solvent is added to the acid. Also a foaming agent often is added to the acid. The foaming agent reduces the weight per unit of acid solution and permits a longer linear column of acid with a minimum of weight Foaming agents thus have a useful purpose, as wells in which deposition of scale takes place usually are pumped with the pump close to bottom and formation pressures are too low to balance any appreciable hydrostatic head.

An efficient, economical method of treating scale-encrusted wells has been developed whereby through circulation and testing the consumption of acid is controlled and complete solution of the scale is assured. In this method the well pump is operated continually during the treatment. First, the fluid level in the well is either pumped off or lowered as much as possible, and 200 to 300 gallons of inhibited hydrochloric acid (usually with a wetting agent added) is pumped slowly into the annual space between the tubing and casing. Thus the acid comes in contact with scale deposited both on the outside of the tubing and on the perforated section of the casing or liner. Additional acid is added at regular intervals, care being taken that the level of the acid in the hole does exceed the normal fluid level of the well. Thus penetration of the acid into the formation is kept at a minimum.

By knowing the pumping rate of the well pump, the time when the first spent acid will reach the surface is estimated. From that time on, samples of fluid from the well are taken from the lead line, filtered, and titrated for acid concentration. If no acid is found in the well fluid it is known that the acid has reacted completely with the scale. Subsequent sampling of fluid and testing for acid are continued at 30-minute intervals. The introduction of acid down the annulus between the casing and tubing and the testing of the returned spent acid are continued until the return fluid shows a slightly acid reaction, indicating that the acid no longer is being consumed by scale in the well and that probably all or most of the scale has been dissolved. When the spent acid at the wellhead is slightly acid, the solution at the bottom of the well probably contains a greater percentage of hydrochloric acid, and in order not to waste this acid the fluid in the tubing is bypassed into the casing and circulated 8 to 24 hours. This procedure, without the addition of more acid to the well, usually assures complete removal of all obstructing scale in the well and complete neutralization of all acid.

By this method, effective agitation of the acid in contact with the scale is obtained, resulting in rapid and complete reaction. Also, spent acid is not mixed with the fresh acid being introduced into the well, thereby preventing unnecessary and undesirable dilution. Furthermore, the normal fluid level of the well is not overbalanced, and therefore penetration of acid into the formation is kept at a minimum.

Removal of Paraffin, Asphalts, and Gums

Some phases of the paraffin problem are encountered in nearly all major oil-producing areas, and the literature on the prevention and removal of paraffin accumulations in oil wells is extensive.[17] The most recent contribution to the subject is embodied in a comprehensive report by the American Petroleum Institute's Eastern District Topical Committee on Production on the findings of a nationwide questionnaire sur-

vey of the paraffin problem with particular reference to new and improved removal techniques that have been introduced during the past decade.[18] Although most California oil fields are free from operating difficulties caused by accumulations of paraffin, asphalts, and gums that separate from crude oil during the production process, these residues admittedly are the principal causes of subnormal production in some wells. In recent years chemical methods have predominated in the removal of wax deposits from wells in California. As a result of the recent trend toward such methods, many operators are using paraffin solvents and heat-generating chemicals.

Paraffin solvents now are available for each type of paraffin found in the California oil fields. In treating wells to remove paraffin by solvents the usual practice is to pour a calculated quantity of properly selected solvents into the tubing and shut in the well for 12 to 24 hours to enable the solvent to work its way to the bottom of the deposited paraffin. The dissolved or softened paraffin then is pumped out by the well pump. In wells producing small quantities of fluid the rods usually are pulled, and the well is bailed because the normal velocity of the inflowing oil is not high enough to maintain loosened paraffin in suspension.

A heat-generating method that has been successful in the Fruitvale field where wax accumulated rapidly is the soda ash-caustic-sulfuric acid treatment.[19] Sulfuric acid is used because heat of dilution is greater than for any other acid, and the reaction between a strong alkali and a strong acid assures a high heat of reaction. After the alkaline solution is run into the hole through the tubing, the tubing is pulled and the level of the alkali in the well is checked with a thief-bottom bailer. The acid then is distributed through the column of alkaline solution by means of an orifice-bottom bailer. Thorough mixing is obtained by running the bailer up and down through the solution 10 or 12 times, after which the well is allowed to "pickle" for 8 hours.

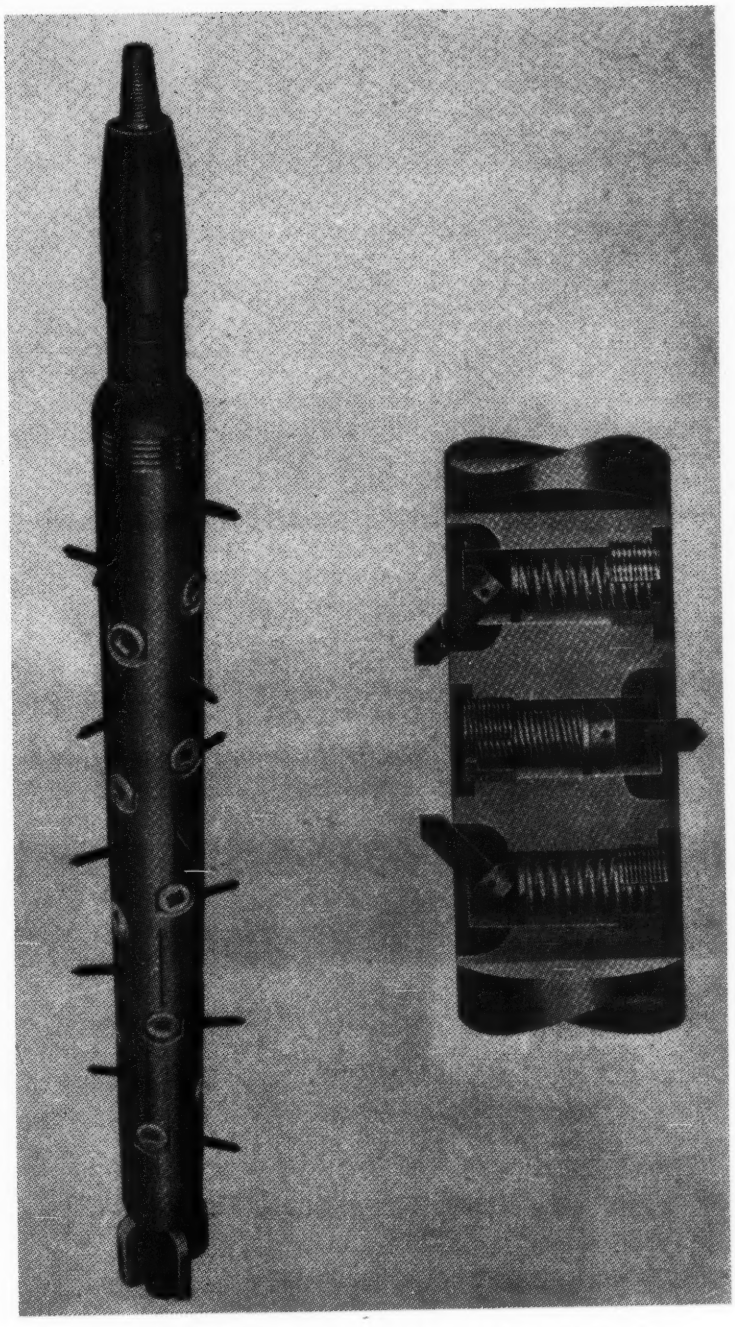
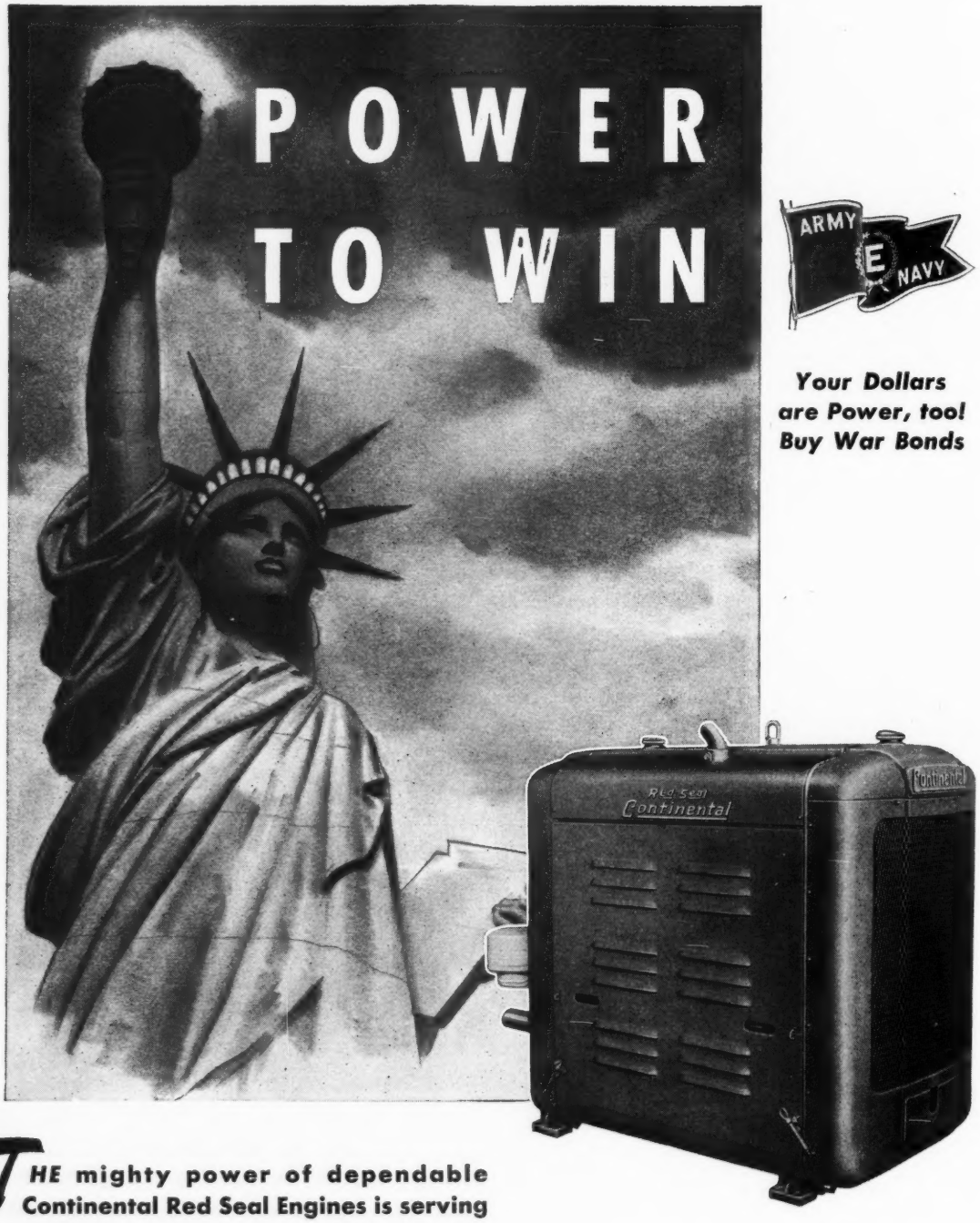


Figure 6—B & B slotted liner cleaner showing detail of blade action.

Other recent developments in exothermal processes for removing paraffin from wells, disclosed in letters patent,[20] consist broadly in generating heat in a well by means of a reaction involving (1) the oxidation of organic reducing compounds by inorganic oxidizing compounds and (2) the reduction of oxidizing compounds by the nascent hydrogen evolved by the action of an acid on a metal.

Removing Liners and Scraping Sand Faces

Removing the accumulated ma-



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terial from the annulus between the perforated liner and the sand face in wells and from the pores in the sand about the wells is considerably more difficult than removing sand bridges or cleaning perforations. Even if the material can be loosened from the face of the sand or disintegrated by solvent, it is sometimes doubtful if the entire surface can be cleaned. Where possible, the most effective method of removing deposited materials from well walls and sands is to pull the liner and scrape the walls of the hole through the entire productive zone by means of a Baker rotary wall scraper. By enlarging the hole and removing the barriers of impervious material, a new sand face is exposed that offers a minimum of resistance to the flow of oil into the well.

The usual practice for removing liners is by inside washing and jarring.[21] Recently, explosive cord has been used to aid in pulling liners. This is done by detonating the cord while a strain is being held on the liner. Usually the effect of the explosive is sufficient to loosen the liner, permitting it to be pulled from the hole.

Developments in Preventing and Removing Mud Sheaths In Completing Wells

The prevention and removal of mud sheaths deposited from drilling fluids on the face of the oil-bearing sands continue to be two of the most important well-completion problems confronting California operators. Although the problem of removing mud sheaths is of special concern in fields where formation pressures are low, it has been observed in some high-pressure fields that the flow of oil and gas into wells also has been greatly impeded by deposited drilling mud. During the past decade considerable attention has been focused by the petroleum industry on methods of drilling in and completing wells, and several methods of preventing and removing mud sheaths have been developed.

Mud sheaths deposited on the face of a productive sand are difficult to remove, particularly after the perforated liner has been set, and yet their removal is necessary to assure the maximum productivity of the sand during the life of the well. Obviously the productivity of a well and perhaps its ultimate yield depend in large part upon the number of perforations open to the flow of oil into the well. Where the initial allowable production of a well is considerably less than the well's potential, however, a plugged condition behind the perforated liner may not be suspected during the early

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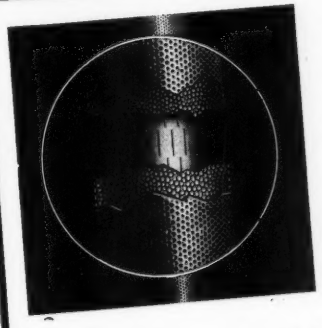

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life of a well, as the well's restricted allotment may be sustained for a long time with only a small part of the producing sand exposed to perforations in the liner. Frequently liners have been withdrawn from wells with a large number of the openings solidly clogged with clay, and examination of a number of the liners from wells producing from formations composed of loose sand showed that the restriction of flow of oil into the well through a few openings caused the oil to enter the wells at high velocity and seriously sand-cut the few perforations that were open to the wells. Laboratory observations indicate that mud sheaths that have not been removed in completing a well "become as hard and impervious to the passage of oil as the cap rock that holds the oil and gas in place in the structure."[23]

In all probability reduced permeability of oil-bearing formations caused by infiltration of water from the drilling mud fluids restricts the flow of oil in many wells. It is recognized, however, that loose or unconsolidated sands of high permeability are largely susceptible to plugging by deposited clay from drilling-mud fluids but are not affected by "water blocking"; on the other hand, sands of low permeability are particularly liable to impairment of their capacity to flow of oil through them by infiltered water from the drilling fluid. The water forms a capillary pressure wall that later restricts the movement of oil into the well. If the permeability of the reservoir sands is high, infiltered water generally does no lasting harm to the oil sands because the water usually is redrawn into the hole when the well is swabbed.

Marked differences in the initial productivity indexes of adjoining wells producing from correlative sands have been noted in some fields, indicating that a well's initial production rate often depends upon the manner in which the wells are completed. If normal productivity is not obtained when new wells are completed there usually is good reason to believe that the mud sheaths have not been effectively removed, that excessive water has infiltered into the sand, or that some other condition is retarding the rate of flow of oil into the well. These barriers to the free flow of oil into wells cause the loss of considerable quantities of oil that normally would be recoverable throughout the productive life of the wells.

Preventing Formation of Mud Sheaths in Wells

The physical and chemical characteristics of mud fluids used in drilling-in operations have an important influence on the successful completion of wells. Consequently, in an effort to prevent the formation of tenacious mud sheaths in wells and minimize the deleterious effects of infiltered water various types of drilling fluids are used. Many California operators use a light-weight drilling fluid consisting

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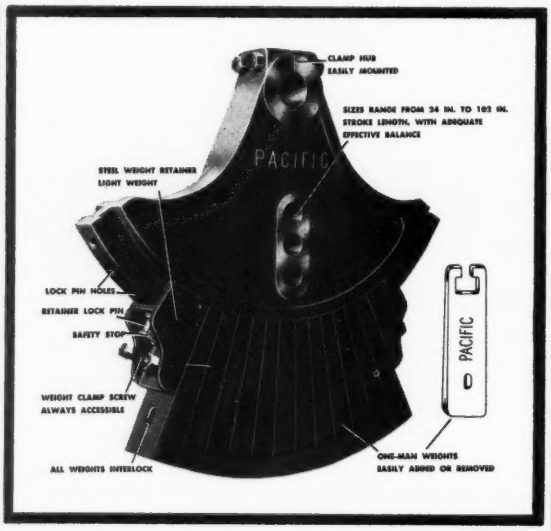
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of bentonitic clay and water for drilling-in and completing wells. The desirable characteristics[24] of such mud fluids include (1) forming a thin, soft mud sheath that can be washed from the face of the sand and (2) minimizing the loss of water to the formation. The use of drilling fluids that form mud sheaths through which large quantities of water can infilter into oil-bearing formations and reduce the permeability of the sand is avoided wherever possible in drilling-in oil wells.

Efforts to reduce the surface tension of water that has filtered through mud sheaths into sands of low permeability, so that the water will flow back readily into the well, generally have not been successful. However, the following method suggested by Travers[25] seems to have considerable merit when the flow of oil into the well is believed to be restricted as a result of reduced permeability caused by infiltered water:

(1) Fill the hole to the surface with casinghead gasoline; (2) follow the gasoline with lightweight mud of fairly high viscosity and apply sufficient pressure to "break down" the formation and displace a considerable quantity of the gasoline into the formation. The purpose of this procedure is to break the water "dam" surrounding the well by application of internal pressure and diffuse the water into the formation or at least to establish numerous channels through the water "dam" through which production might be obtained.

Good results have been obtained in some fields by using oil as a drilling fluid; but where the oil-producing formations consist of thick zones of sand and interbedded shales, oil mixes with the shale cuttings, frequently forms tough, plastic coatings on the bit and drill pipe, and plasters the wall of the hole with a covering that is more difficult to remove than ordinary mud sheaths. Moreover, in certain areas oil-drilling fluids tend to cause the formations surrounding the bore hole to cave; and if the formations contain water, oil-drilling fluids take up water and soon are no longer desirable for use in drilling. Oil-drilling fluids have little or no gelling properties, so that bit cuttings settle rapidly and stick the drill stem when circulation of fluid in the well is stopped Furthermore, the loss of oil from oil-drilling fluids to the formations usually is high, but that is seldom serious, especially if the productive zone is thin and can be penetrated rapidly. Some operators use ordinary mud fluids while drilling through oil-bearing sands and then underream the holes, using oil before installing liners. Experience has shown, however, that this practice is not as effective as using oil while drilling in the zone of oil-bearing sand.

Recent efforts to prevent the formation of mud sheaths in wells and to minimize the infiltration of water from drilling fluids into oil-bearing sands has led to the development of several types of oil-base mud fluids.[26] Operators are using these drilling fluids to an increasing extent in both low and high-pressure areas. In the latter areas weighting materials are added to oil-base mud fluids to increase their density, thereby preventing the danger of wells blowing out. Experience shows that the initial productivity indexes of wells drilled with oil-base mud almost invariably have been higher than those of offset wells drilled with water-base mud fluids. Oil-base mud fluids appear to have great possibilities toward becoming ideal drilling fluids to use in completing wells.

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The third installment will be carried in the next or 1st October issue.

Postwar Conditions Discussed at Nomads Sept. Meeting

Postwar conditions and naval action in the Pacific were the topics discussed at the regular monthly meeting of the Los Angeles Chapter of Nomads held in Los Angeles on Wednesday, September 8, 1943. There were 65 Nomads and guests in attendance at this meeting which was preceded by a get-together and dinner.

The master of Ceremonies for the evening was Earl Cater who introduced the first speaker, Walter E. Elieson of the United States Department of Foreign and Domestic Commerce. Mr. Elieson's subject was "Markets After the War" and in his talk the many factors that will be of vital influence in the conduct of postwar business were touched upon. Following the address numerous questions of interest to the oil equipment industry were answered by the speaker.

The next speaker, Al Brick, who was head of Fox Movietone News in Honolulu at the time of the bombing of Pearl Harbor, preceded his

(Continued on Page 30)

National Supply Co. . . . Torrance Plant—Expands for War Activities

The Torrance Plant of The National Supply Company, situated on a 38-acre tract in Torrance, California, already possessed facilities readily adaptable to the manufacture of war material when the United States Government started placing contracts for specific products. Expansion of plant facilities was, of course, necessary to take care of all the work assigned to this plant. In addition to extending existing buildings, a new Ship Shafting Building more than 700 feet in length for handling naval contracts was constructed and completed in 1942 and a Plancor Building for making airplane landing gears was finished early in 1943. The facilities provided by these new plants, combined with those of the existing plant and its additional equipment, make the Torrance Plant one of the few comprehensive units west of the Mississippi.

Produce Alloy and High Carbon Steel

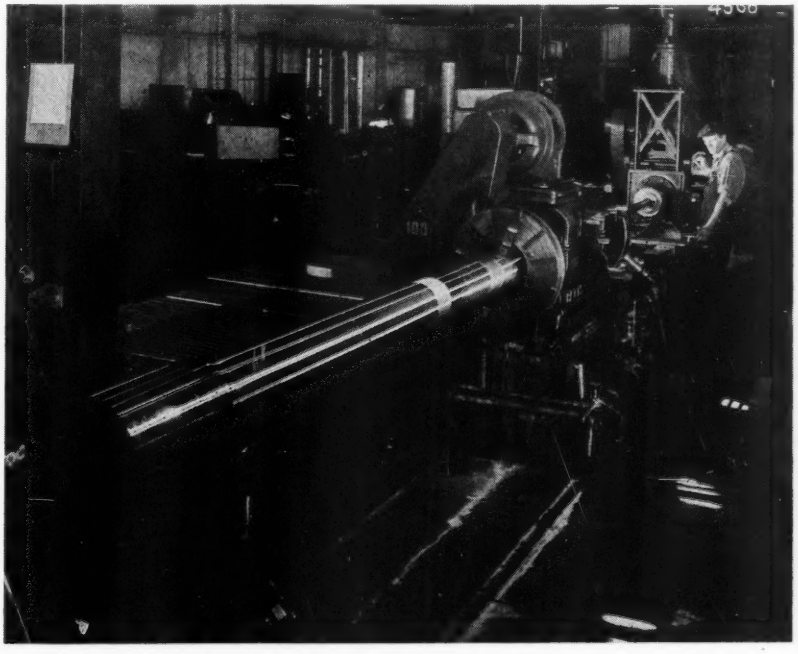
It is probably not generally realized that, in addition to forging, heat treating, machining, fabricating and welding, this plant produces its own alloy and high-carbon steel to meet Army and Navy specifications for specific products. Three electric furnaces are in constant service and are capable of turning out a daily average pour of 150 tons. They are charged with scrap steel brought in from various outside sources and with turnings and other scrap produced in the plant which are returned to the furnace for reheating. No formulas are furnished for making steel to any certain specification; the finished product must meet the tests laid down by the Army and Navy and it is up to the ability and experience of the steel makers to control the heat and ingredients so that ingots of proper characteristics are obtained. Numerous tests are therefore made during the heat so that the necessary characteristics of the ingot are assured before the metal is poured.

Fortunately, the plant had long been making the steel used in the famous "Ideal" oil equipment and had an experienced and efficient steel-making personnel to carry on when work on war material started. Testing and other laboratory equipment for the control of products was in service and was also available for immediate use, although more equipment of this kind has naturally been added to meet the increased demands. Alloys are scarce and have to be used with greater effectiveness to secure products that, in some cases, must be of better quality than were previously produced with a more abundant supply of alloys. The ingenuity of the personnel, however, has overcome these various obstacles and products turned out have consistently met the specifications of the Army and Navy. Steel made to similar specifications is also furnished to other ordnance plants in billet form.

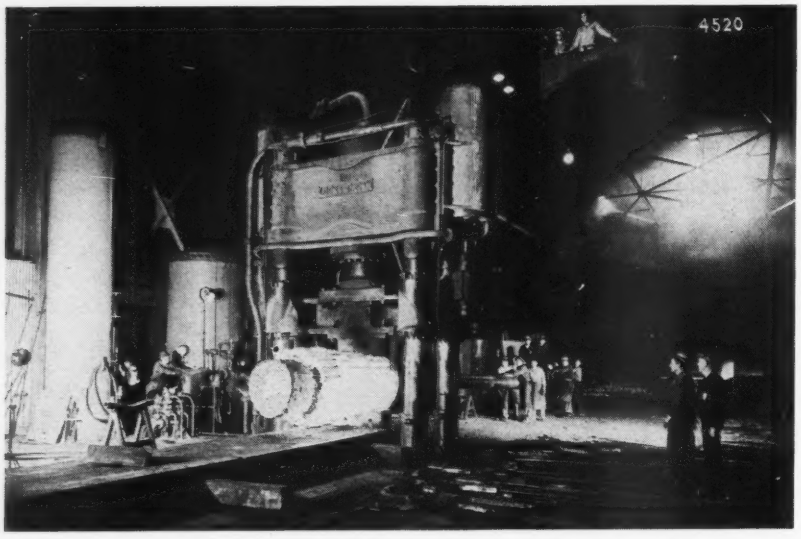
New Equipment Installed

The extent of new equipment installed for the manufacture of ship shafts and armaments cannot be given in detail. In the new building being used for naval contracts is a 1500-ton forging press which handles ingots up to 50,000 pounds. Here, too, is a battery of the latest type of forge heating furnaces and two preheating furnaces of such capacity that ingots do not have to be cooled between casting and forging. A special double-hearth, traveling furnace was installed for the heat treating of large shaftings. This furnace, 61 ft. in length, is made with two hearths and the furnace itself travels on rails from one hearth to the other. One of the hearths is loaded while the other is in operation and when one heat is completed the furnace is moved over the other hearth. This not only saves time but allows careful arrangement of the charge so that any hazard of kinking or other trouble is eliminated.

One end of the Ship Shafting Building consists of a machine stop with six turning and boring lathes ranging in length up to 152 feet. Three of these are capable of boring 60-ft. lengths of the largest shafts. Ship shafts made to date are up to 20-in. diameter and have been



Boring 90 mm M1 Gun Tube at Torrance Plant of The National Supply Company.



Forging 25-ton ingot on 1500-ton press in new ship shafting addition to The National Supply Company's Torrance Plant

furnished for escort aircraft carriers, mine sweepers, sub chasers, destroyer escorts, cargo vessels and seaplane tenders. Thrust shafts, connecting rods and crank webs have been made for cargo ships. Rudder steps are also cast.

Gears for B-24 Bombers

The Plancor Building recently completed is at present confined to the making of landing gears for B-24 bombers. Here are long rows of welding booths where the welding of the parts into the finished units is done. Most of the welding of this type is being done by women who have demonstrated their ability for this kind of work.

Among the other armaments manufactured are gun barrels which are rough machined, some being bored at the plant and others sent out for boring elsewhere. The gun sizes range from 20 mm to 4½-in., the lengths of the finished barrels being from 58¼ in. to 189¼ inches. These are forged with test metal on the end and, like everything else being made at the plant, are subjected to the most rigid tests. Breech blocks for anti-aircraft guns and blanks for loader trays are also made. In addition to the guns and auxiliary gun equipment, tank castings consisting of the front hull section for M-5 tanks are made and, after passing their tests, are sent to tank factories for assembly.

Supply Wide Variety of Equipment

The war effort of the Torrance Plant does not end with the manufacture of certain products at the plant itself; it supplies other war industries with equipment. Centrifugal casting machines are made for other companies and 10,000-lb. crucibles are built for magnesium manufacture. The steel billets furnished to other ordnance plants, as stated above, are utilized for many purposes in supplying the armed forces with equipment.

The Torrance Plant is further equipped for handling large welding jobs and this facility is available for all types of welding operations both in connection with plant operations and for outside concerns. For welding pieces of exceptionally large size there has been installed a 30-ft. universal manipulator or positioner in which the object to be welded can be turned to any angle or direction and easy access thus secured to all parts. This device is located over a large pit and is operated electrically by push-button control.

Oil Equipment Manufacturing Increased

While new buildings have been erected to take care of the vast amount of additional work imposed by war contracts, all operations have been coordinated with the main plant and its facilities utilized to the greatest extent in securing maximum efficiency of operation with a subsequent maximum output. Manufacture of oil equipment is not only being continued but a present increasing demand for this equipment is being met. Oil equipment itself is actually a war industry and present indications are that more of it will have to be furnished in the immediate future. With the new facilities now available and with the increased efficiency now developed through experience gained during the past year, the oil equipment requirements can be met without interfering with the fulfillment of shipbuilding and armament contracts.

Awarded Army-Navy "E"

The Torrance Plant received its Army-Navy "E" Award on May 19, 1943, just before the opening of the new Plancor Building in which the manufacture of bomber landing gears is now being done. Exhibits of the various ship shaftings and armament products were displayed in this building at the time of the ceremonies which were held in the same place.

Nomads September Meeting

(Continued from Page 28)

talk with motion pictures (in sound) of the bombing. After discussing this attack, Mr. Brick, told of his experiences with the Navy in the battles of Midway, Bismark and Coral Sea. He was stationed on several aircraft carriers and was in action in planes from the carriers. At times, in addition to his photographic work, he served as gunner and radio man. Before getting back to his country he spent some time on Guadalcanal, being there while the island was in the process of being captured.

Among the foreign guests at the meeting were his Ex. Jorge Zelledon, Secretary of the Interior of Costa Rica, and Hon. Carlos Grimm, Vice Consul of Mexico.

Due to the great interest in the second speaker's adventures, many questions were asked after he was through his talk and the meeting was not turned back to the president for adjournment until after 11 p.m.

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SINCE 1890

Bethlehem Supply Company Turns Out Wide Range of Products for the War Industries

Immediately after the United States became an active participant in the present world conflict, Bethlehem Supply Company, like most other large, industrial concerns, turned its attention from peacetime pursuits to the production of equipment for the armed forces. More than three quarters of the company's present output is for military purposes. A few of the most interesting developments will be discussed briefly in the following.

Anchor Hoists for Landing Barges

One of the country's larger shipyards now engaged in naval construction placed an order for several hundred hand operated stern anchor hoists for tank landing barges. The design of these hoists was made by Bethlehem Supply Company, from a pencil sketch supplied by the shipyard. Delivery of the first lot was made in 45 days after the receipt of the order. Subsequent deliveries have also been completed on schedule.

Sub-Contracting Speeds Deliveries

The prompt execution of these orders was made possible by sub-contracting, which served the dual purpose of speeding up the job and distributing the work among local plants.

Heat Exchangers for Synthetic Rubber Production

A large manufacturing company placed an order for several hundred cast semi-steel heat exchangers, for use in synthetic rubber production. Due to their small wall thickness and large overall dimensions, these exchangers presented difficult casting and machining problems. They ran from 5 to 8 ft. in length, and were made in six different diameters, ranging from 20 to 46 inches. After machining, each shell had to pass a hydrostatic test at 150 lbs. per sq. in., maintained for 1 hr. without any leakage.

Boring the case of a Gear Reducer on a large horizontal mill. The boring for all the shafts is done at a single setting to prevent any misalignment. Gear Reducer used in Bethlehem Pumping Units.

The machining operation consisted in boring the inner diameter of the shell, full length, facing of the flanges, and drilling the flanges for bolts. The boring of these shells their full length was a difficult problem. A large gun lathe in the shop, and a smaller lathe obtained from another of Bethlehem's plants were retooled and equipped for the job. Production proceeded without a hitch and deliveries were completed according to schedule.

Gun Elevating Mechanism for Tank Destroyers

A job worthy of mention, because so different in character from the work normally carried out by Bethlehem Supply Company, is a gun elevating mechanism for U. S. Army tank destroyers, of which several thousands have been turned out. This is a small, compact precision mechanism, built to very close tolerances and with a high degree of finish. A very extensive and thorough tooling job was necessary before production could be started. The handling of two products so widely different in character as the heat exchanger shells and these gun elevating mechanisms in the one shop at the same time is a fine testimony to the ingenuity and skill of all concerned.

Steam Pumps for Navy Transports

Complete vertical simplex direct acting steam pumps for Navy transports were supplied to one of the country's larger pump manufacturers. The pumps were built to the manufacturer's drawings and specifications, subject to their inspection. The types manufactured included main and auxiliary boiler feed pumps, fuel oil service and transfer pumps, and bilge pumps. Although the shop had never built steam pumps before, the units were all de-

livered on time and passed all the required tests. An ingenious universal test stand was built, capable of taking any one of the four sizes of pumps involved.

A second order for the same type of pumps has been received for vessels now under construction in a Pacific Coast shipyard, for the United States Maritime Commission.

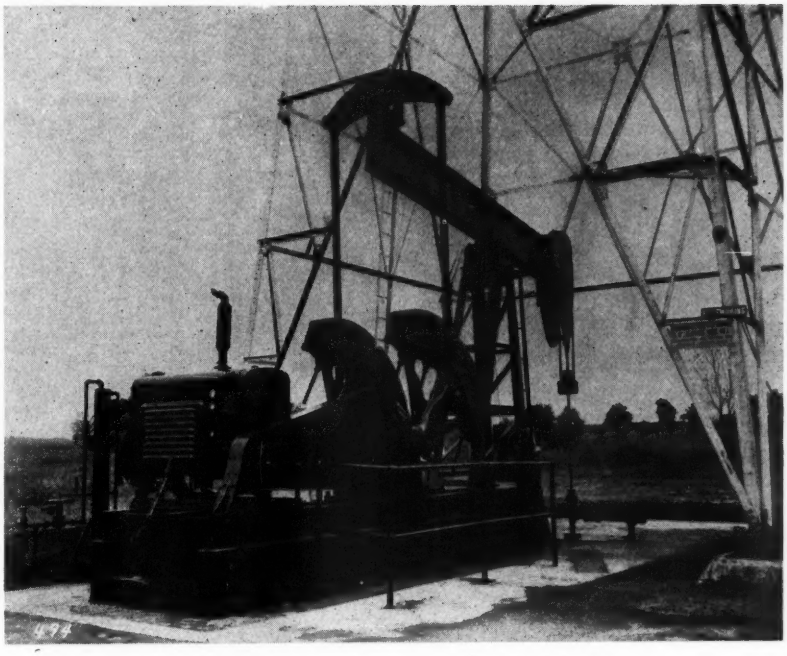
Valves for Portable Pipe Line

Special combination gate and check valve bodies and parts, fully machined, were supplied in large quantities for portable pipe lines used by the U. S. Army. The bodies and principal parts are cast semi-steel. This job is similar to the work regularly carried out in the plant, but the great quantities of valves and the relatively large tonnage of castings involved make the contract worthy of special mention. The valves weigh about 200 lbs. a piece and must be bored, the inside seats faced and threaded, and the flanges faced and drilled.

Several orders for machine castings for automatic control valve parts have also been received for the same pipe lines. Work on these has been running well ahead of schedule.

Other defense contracts completed or under way include:

- Worm gear housings for Navy landing boats,
- Frames for heat treating furnaces used in bomb manufacturing plants;
- Special machine tool bases for bomb manufacturing plants,
- Hammer forgings for:
  - Landing boat anchor hoists,
  - Naval ordnance plants,
  - Army powder plants,
  - Army tractor cranes,
  - Army barrage balloon winches,
  - Aircraft manufacture,
  - Cranes and hoists for war industries;
- Castings for:
  - Melting pots in airplane factories,
  - Forming dies for airplane factories,
  - Cast furnace parts for gun barrel manufacturers,
  - Heat exchanger parts for aviation gasoline refineries;
- Forgings:
  - Steel hangers for armor plate plants;
- Other Contracts:
  - Mill tables and cranes for steel mills,
  - Assembly jigs and fixtures for airplane factories.



Bethlehem Pumping Unit with Gas Engine Power

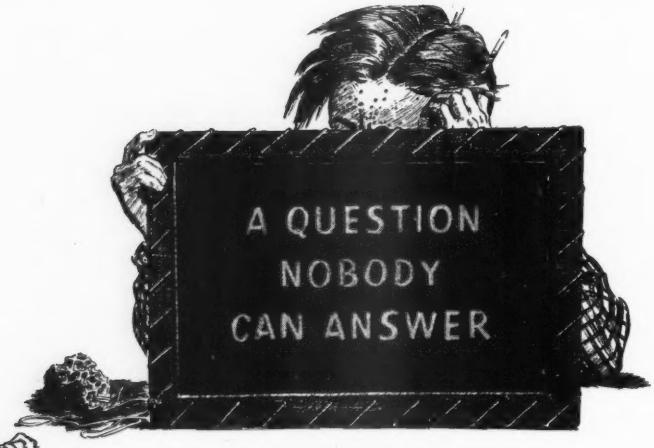
As previously stated, about one-fifth of the plant's production capacity is presently devoted to the normal peacetime production, which includes pumping units; a new portable hoist designed to speed up the servicing of wells; casing heads, tubing heads, stuffing boxes and pumping tees. Last spring Bethlehem appointed the Petroleum Equipment Company, of Los Angeles, as distributors of Bethlehem pumping units on the Pacific Coast.

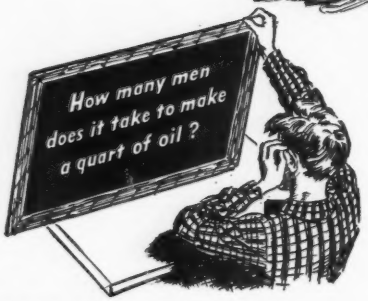
George S. Colley, Jr. Held as Japanese Prisoner

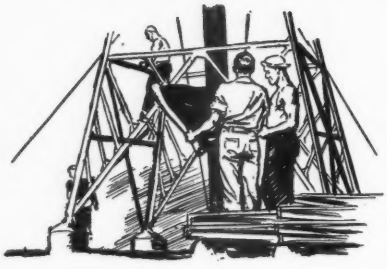
Unreported in the South Pacific war zone since the fall of Manila, George S. Colley, Jr., Vice President of W. A. Bechtel Co., is alive and well on Borneo, although a Japanese prisoner. This news, transmitted on August 21 through the International Red Cross headquarters at Geneva, will be happily received by his many friends in the petroleum and heavy construction industries following the long period of uncertainty.

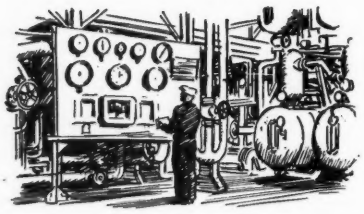
Colley has been identified prominently with the Bechtel organization's extensive pipe line construction activities, for many years as the executive in charge of this phase of the company's work. When war was declared he was engaged in building augmented naval and air facilities at Cavite on Manila Bay, directing construction for his company as Project Manager under ocean-wide naval contracts being executed by Contractors Pacific Naval Air Bases. Both at Cavite and across the bay on the cliffs of Bataan the construction organization continued its work under constant attack until forced to capitulate by the proximity of Japanese occupational forces.

In early January, 1942, Colley, together with his wife, Mr. and Mrs. Harry Webber and Ashton Laidlaw left Manila in a motor launch. They were traced as far as Balabac Strait northeast of Borneo, and before reaching this point the party had transferred to a small sail boat.





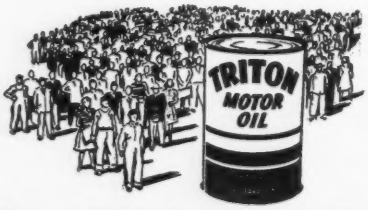


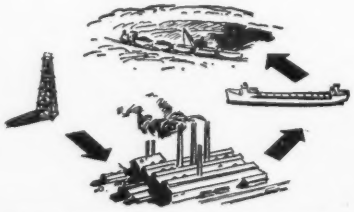


1. We're in the business, but we don't know. We can tell you how many different men and skills it takes to perform *our* part of the operation. If you begin with the geologists, paleontologists, surveyors and seismograph crews that look for oil land...

2...and add the rig builders who put up the derrick; the drillers, derrickmen, rotary helpers and firemen who drill the well; the production foremen, pumpers and pulling crews who service it after it starts to produce...

3. ...the pipe line crew, gaugers, refinery stillmen, chemists, truck drivers, warehousemen, bookkeepers, stenographers, painters, carpenters, welders, salesmen and scores of others—*each one specializing on one particular phase of the operation...*

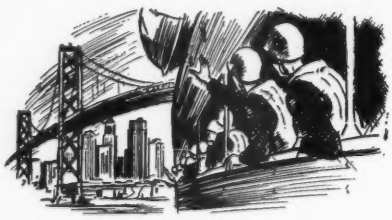




4....you find that it takes *more than 400 different skills* in the Union Oil Company *alone* to bring you a 35c quart of Triton Motor Oil. But that's just the beginning. If we go back to the men who made the pipe that carries the crude that's refined into Triton...

5....and trace their raw materials back through steel mill and ore ship to the iron mine *(pause for breath here),* then repeat the process with all our equipment—refineries, tools, trucks, cans, and even *pencils*—it begins to look as if almost everyone in the country had a hand in the operation.

6. At any rate, no one could possibly figure out the exact number of men involved. And, fortunately, nobody has to. For under our *free* economy those things are taken care of by the law of supply and demand. No one has to *assign* men and materials to different jobs as you do in a *planned* economy.



7. They flow where they're needed—*automatically.* How efficiently this works has been brought home to all of us during this war, when the law of supply and demand has had to be suspended temporarily in some cases and *planned* economy instituted in its place.

8. But the best testimonial is America itself. For our country, under Free Enterprise, has achieved the highest standard of living and the greatest capacity for war production the world has ever known. Without the *automatic* efficiency of a *free* economy this could have never been done.

This series is dedicated to a discussion of how and why American business functions. If you have any suggestions or criticisms we hope you will feel free to send them in. Write: The President, Union Oil Company, Union Oil Building, Los Angeles, California.

UNION OIL COMPANY
OF CALIFORNIA

AMERICA'S FIFTH FREEDOM IS FREE ENTERPRISE

How Lufkin Has Grown

In peace as in war the Lufkin Foundry and Machine Co. has played a leading role in the building and progress of Lufkin and central East Texas. From its small start just after the turn of the century, it has grown to become the largest peacetime foundry and machinery manufacturing company in the southwest and one of the most important war production agencies of the nation.

The full story of the Lufkin Foundry and Machine Co. goes back to 1900 when a group of lumbermen in the deep East Texas area felt the need of a machine shop to repair their sawmill machinery. The nearest shops were in Shreveport and Houston and consequently repairs could not always be secured when needed.

Thus was started a little shop with a few wooden buildings, a limited number of tools and very little money, but with a purpose of serving the community and area in which it was situated. Throughout the four decades that have followed the Foundry has kept the thought of service and production uppermost in its programs.

With the vanishing of the timber supply—although the lumber industry within Angelina county today is flourishing—it was found necessary to direct the energy, activity and experience of the large organization to other productive fields. With this idea in mind, attention was directed to the oil industry.

After an exhaustive survey of the refinery and production divisions of this industry, the foundry began manufacture of special fittings in the Lufkin plant. Large high-pressure screwed fittings were manufactured for pipe lines, and later replaced by welded lines.

Research Continued

In the meantime research was going on in the production end of the business and it was found that while improvements had been made, the basic principles used in the early days in Pennsylvania for lifting oil to the surface were still employed. This led to the development and application by the foundry of reduction gears for pumping oil wells and the later development of the patented Trout rotary counterbalance crank.

Advantages Seen

The advantages of the Lufkin Pumping unit, a radical departure from the old type of inefficient rig, were readily recognized by practical operators and oil company engineers and the acceptance of this method of producing oil soon followed.

Within the short space of two decades this new method of pumping has so grown in favor that a majority of large producers, as well as the small producers, have standardized on this particular type equipment.

Despite the fact there were many manufacturers in this field, the position of the Lufkin Foundry was a dominant one and now Lufkin pumping units are found in practically all the major oil fields of the nation, and in every section of the world.

Large Plant Area

Today the Lufkin Foundry and Machine Co. covers a large area of land, with thousands of square feet of space. Since the taking on of war contracts two new buildings have been constructed, one housing the gun carriage department and the other a battery of gear cutting machines. It has gear cutting machinery no other foundry west of the Mississippi river possesses, and consequently is equipped to turn out large and important jobs for the armed services. Ordnance Officers have aptly nicknamed this plant the Gear Arsenal of the Southwest.

Its foundry building and other equipment is of the most modern type, the entire plant having been retooled within the last five years. In the foundry is the world's largest hydraulically operated molding machine, weighing more than 80,000 pounds, and having a lifting capacity of 17,000 pounds. A long and detailed description of the equipment might be given which would be of interest to the technical-minded, but it is sufficient to say that in the Lufkin Foundry and Machine Co. today will be found ALL the equipment and tools needed to turn out the most perfect job.

(Turn Page)

Heavy guns get the job done as has been demonstrated. One of our first undertakings was the production of 155 MM and 4.5 MM gun carriages. Steadily and on time these carriages have poured down the production line and are still leaving in a steady stream. Here again Lufkin "know-how" was used to full advantage. These guns are helping our side in a decisive battle.

Army-Navy "E" Award Climaxes 38 Years of Fine Production.

Foundry Placed in Select Group of Nation's War Industries

The award of the Army-Navy "E" to the Lufkin Foundry on June 24, 1943—first award of its kind in East Texas, and placing the foundry in the select group of one and one-half per cent of all war industries that have received such recognition, is the climax to a series of acts of recognition by the armed services; it is a climax to 38 years of outstanding service to community, state and nation by a growing industry.

Throughout the past year and a half since Pearl Harbor the foundry and its workers have been steadily commended by Army and Navy procurement officials for production records. When North Africa was won by the American and British troops, the foundry received a telegram from General Eisenhower, sent through the War Department at Washington, expressing appreciation for the part it had played in the victory.

Visioned Need

For many months now the Lufkin Foundry and Machine Co. has been engaged in all-out war production. President W. C. Trout and executives and directors of the Lufkin Foundry realized long before Pearl Harbor that production and more production was needed in the war that might come.

They did not sit back and wait for the government to give them a job. Even before lend-lease the Lufkin Foundry and Machine Co. was negotiating with the British government for war production. After lend-lease it was negotiating through lend-lease officials.

It had to prove it could do this vital war job and the proof was given the proper authorities. Trial contracts were received and the foundry's production record immediately marked it as one of the better producing agencies in the nation.

With the armed services appealing for a great output of war materials after we had been plunged into the war by the cowardly stab in the back over Pearl Harbor on December 7, 1941, it was only natural both Army and Navy procurement officials turned to the Lufkin Foundry.

The full story of this production record cannot be told at this time; nor can it be revealed how many men and women are engaged in turning out war products; how much the payroll is at this great industry —censorship regulations prevent all this.

The Post-War Period

Discussing the post-war period recently, President W. C. Trout of the Foundry declared the job right now is "to win the war."

"We must devote our every effort toward producing every single item of war materials it is within our power to manufacture," declared the foundry chief. "The lack of one gun carriage, one gear or one of the other units the foundry is producing might mean the difference between life and death for soldiers on the battle-front."

After the war there very naturally must be a change-over from current economy to a peace-time economy. War contracts will be cancelled or reduced in many plants and production naturally will drop. At the same time there will be the returning men, many of whom will seek their own jobs.

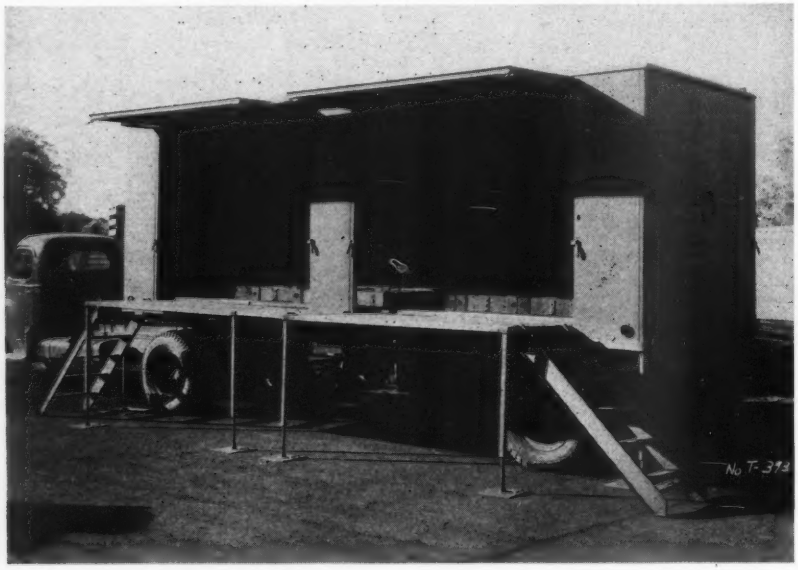
It is the duty of industry and of business to do all it can to bridge this gap between war and peace; and private industry can do it much better than a benevolent type of government that would furnish security from cradle to grave. These are views of the foundry president.

As for the foundry itself, its executives headed by the long-time president already are planning new production schedules in peace-time to offset the great war production schedules of today. Friends who have talked to Mr. Trout say he has a plan for use of every bit of space in the foundry plant, including the two new structures built for the gun carriage and gear cutting jobs.

Some of the machines in the foundry may not be retained but those that are will be utilized.

It is pointed out that the Lufkin Foundry has adapted itself to the changing conditions through the years, and its executives are confident they will be able to adapt their production schedules to the post-war era.

"If it takes new products, then we will manufacture them."



Pictured is one of the many laundry trailers or "de-lousing" units being by Lufkin Foundry & Machine Co. for the Army.

The fast PT boats, made famous by their exploits in the Philippines, are carried to foreign ports in special cradles from which they float free if the vessel should be sunk. They then can be used as lifesaving boats.

Oil Workers are War Workers.

This Light Shall Never Fail ☆ ☆ ☆ ☆

To the end that the light of Liberty shall never dim — America's men and resources are devoted. Prime among the devotees of these principles are the Shopmen of this country. Small and large alike the plant wheels turn by day and night to produce the goods which make our Nation ever mightier and thus crush the forces which hinder our peaceful pursuit of the ideals which have made us great. To this end we devote our energies.

In the early days of Wilmington oil field development a need arose for control of sand entrance into the well. As a result J. B. Nelson introduced, pioneered and developed the Pre-Pack Gravel Liner.

The first liners proved of great value and, as a result, it has become common practice to use them in all wells. Many of the wells drilled prior to the development of this method have been subsequently redrilled and prepack liners used, thus increasing the oil recovered.

To properly utilize the production facilities employed in the manufacture of prepacked liners J. B. Nelson branched into the manufacture of hydraulic well pulling units, portable drilling masts and spark-plug drilling rigs.

These same shop facilities have at all times, and still are, regularly employed by oil producers for the repair and maintenance of equipment on a scale not practicable in their own shops.

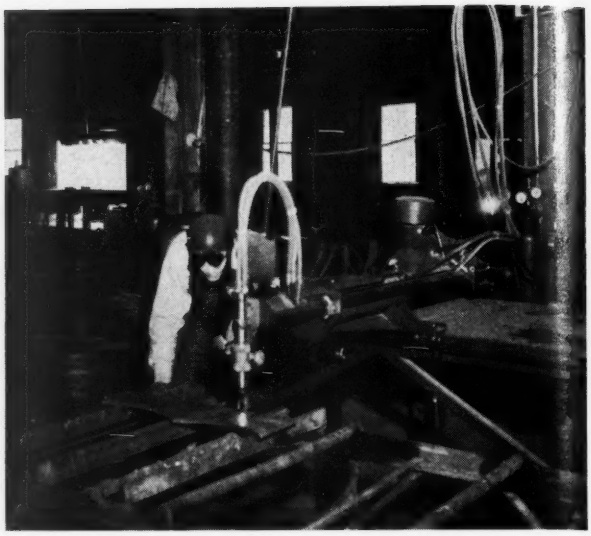
Being in full scale production at the time when war seemed eminent, the Nelson shop was immediately adapted to the production of wartime products as a prime contractor. Among the jobs of great value to the war effort have been the fabrication of Maritime fuel and water tanks, especially designed tools and connections, torpedo net defense, gun mounts, armor shields, ventilation equipment and many specially tooled items on emergency demand by government agencies.

Owing to the large volume of work placed in the hands of J. B. Nelson, the plant facilities have been greatly expanded and, in order to assure a continued supply of skilled man-power, a welding trainees school is maintained in conjunction with the facilities of a large educational institution.

The establishment of this skilled personnel and modern equipment is a pledge to the California oil producer that, once the pressure of wartime manufacture is eased, his needs, desires and problems again will be the prime consideration of this plant —albeit—during this entire critical period, no reasonable demand for service or products has failed to receive the prompt, efficient attention which characterizes this organization.

(Turn Page)

Fabrication of Gravel Packed Liners for domestic oil use.

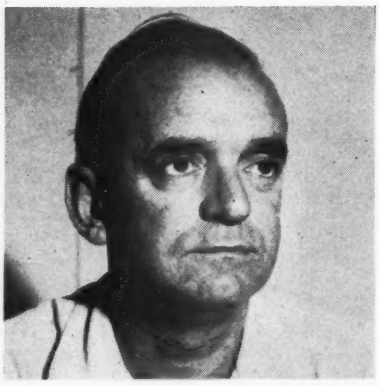


Cutting Machine at work in the J. B. Nelson shop.

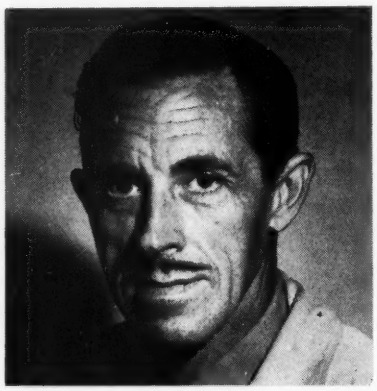
View of J. B. Nelson machine shop showing manufacture of Maritime Commission parts.

In the background torpedo net defenses are under construction. Operators in foreground are welding gun mounts for maritime use.

Earl Hirigoyen



J. B. Nelson



Hal Miller

AQUAGEL

OVERCOMES MANY DRILLING DIFFICULTIES

AQUAGEL has been used for many years in both rotary and cable tool drilling to overcome drilling difficulties from grass roots to completion.

When spudding in, AQUAGEL controls surface water, checks caving and consolidates loose formations. The thin mud cake which AQUAGEL provides is particularly advantageous when cementing casing because a tighter bond between casing and hole is effected and there is less chance of water intrusion. When there is a thick cake on the walls of the hole there is greater probability of water channelling between the walls of the hole and the cement. When water sands separate oil sands, this is particularly important.

When AQUAGEL is used, no mud change is necessary when entering the producing zone because of its low water loss. When cleaning up, the thin AQUAGEL filter cake disintegrates easily into small, fragile pieces which readily swab through the liner. Its quick removal from the face of the formation exposes all the oil sand. Swabbing is reduced and higher potentials are realized.

MAKES STRAIGHT DRILLING SAFER, FASTER, MORE ECONOMICAL

AQUAGEL extends the interval of straight drilling. Lost circulation, and heaving and sloughing caused by water infiltration are reduced to a minimum. AQUAGEL is economical because it yields about 100 barrels of mud per ton. This high yield means less to carry, less to store and less to handle. After completion, spare sacks of AQUAGEL can be easily and quickly moved to another location without loss.

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THIS LAUGH

OFF!!

A widow is the most fortunate woman in the world. She knows all about men and all men who know anything about her are dead.

How long do you expect to drive around? You owe me $18.50 now.

Bettter back up to fifty cents, thash all I got.

I've decided to get a divorce. My wife hasn't spoken to me in six months.

Better think again. Wives like that are hard to find.

A little girl had been left in the nursery by herself, and her brother arrived to find the door closed. The following conversation took place:

"I want to tum in, Cissie."

"You tant tum in, Johnny."

"Why tant I?"

"Cause I'm in my nightie gown and nursie says little boys mustn't see little girls in their nightie gowns."

After a reflective silence on Johnny's side of the door the miniature Eve announced triumphantly: "You tan tum in now, Johnny, I tooked it off."

A henpecked looking little man and his wife arrived at a concert late.

"What are they playing?" he whispered to the man beside him.

"The Fifth Symphony," he was told.

"Well," he muttered, "thank goodness I've missed four of them."

The school boy was wrestling with examination questions. Finally he came to: "State the amount of oil exported from the United States in any one year."

With sudden inspiration, he wrote: "In 1492—none."

"Just think of it; steaks only 20 cents a pound, eggs 15 cents a dozen, chickens 10 cents a pound, and milk 5 cents a quart."

"Where?"

"Oh, nowhere, but just think of it."

Old Maid: "I bet that man was embarrassed when you caught him looking over the transom."

Second O. M.: "Gosh, yes, I thought he'd never get over it."

An Englishman and an American were presented to the ruler of one of the small Eastern countries. On looking over the Englishman's passport, the dusky monarch said:

"I see, sir, that you are a British subject."

"I am, sir."

"And you, sir, are a subject of the United States?"

"Subject, hell!" the American shouted. "I own part of the United States."

"McDuff, I'm in love with your wife. If you will give her to me I'll pay her weight in gold."

"Let me ha' a fu weeks, first."

"What for, to think it over?"

"Na, mon! To fatten her."

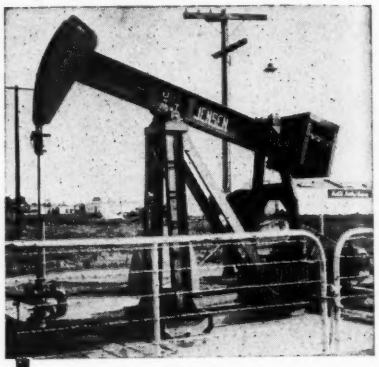
Then there was the young lady about to go on the witness stand. "Must I bare everything?" she asked.

"No, no," said her counsel. "Merely cross your legs."

Everybody is ignorant, only on different subjects."

Police radio call: "Car blocking alley at Newton and Plymouth Aves. N." Squad car replied: "Some woman stripped her rear end. Will have it removed."

Minnie the Moron, when asked the rank of the navy man she was running around with, said she didn't know for certain but she suspected he was a chief petting officer.



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Precision Gage Industry Blossoms on West Coast

Backed by years of preparation and study, the manufacturing of precision ring, plug and special types of gages is now developing as a fast growing West Coast industry, supplying an important share of the unusual war requirements for such tools.

As late as 1940, Kobe, Incorporated—original manufacturers of hydraulic pumping equipment—discovered that scarcity and delayed deliveries of gages were definitely hindering the smooth flow of western industrial production. After a particularly long wait for a special type of gage which they themselves required, officials of Kobe decided to manufacture their own. Selecting trained mechanics already employed in the regular precision operations of its shops, the company started making gages needed in the manufacture of hydraulic oil well production equipment. Originally, the work was done with but two men; today, there are 54 employees working three shifts a day making the highest quality of master and reference gages which are shipped to war plants all over the United States.

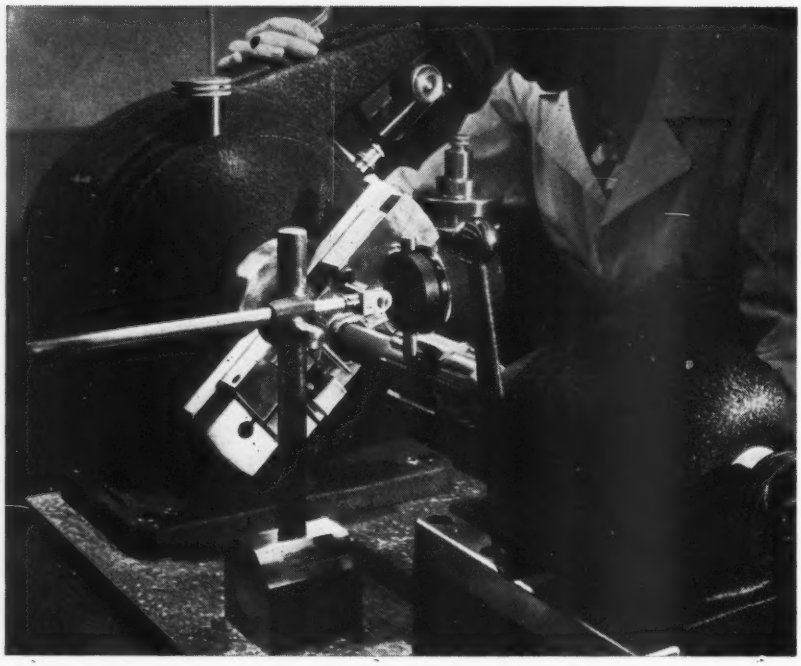
View of the thread grinding department where Kobe gages are threaded to .0001 tolerances.

The manufacturing of gages was an early and natural interest in the Kobe company because of the precision machine work and practices fundamental to the products it has always made, while the idea of manufacturing them on the Pacific Coast has proved a boon not only to war time manufacture but to the entire industrial west. For the first time an immediate local source for highest quality gages in quantity is available to western industrialists. Right now, of course, Naval and Army ordnance requirements occupy Kobe's full facilities.

Checking gage on one of the largest instruments in the country. The specially built Kobe unit used to measure special gages up to 14 feet in length.

The first unit produced was an electric gage for the determination of maximum accuracy limits and was designed originally for the diametric and concentric check of hydraulic pump liners which were four to five feet in length. Continued improvement, however, developed a present-day gage for accurately checking these liners in lengths up to 25 feet.

The foresight of Kobe, Incorporated, in pioneering gage manufacture has proved of immense value to the nation's war effort. When the Japanese struck on December 7, 1941, Kobe personnel was already trained and experienced in the many intricacies of gage manufacture. Soon afterward, the Ordnance Departments of the Army and Navy recommended the expansion of the gage manufacturing facilities—after tests had proven the accuracy of the products manufactured. This subsequent plant expansion program developed manufacturing facilities for precision gages which involved an



Determining the angular accuracy of a Kobe special spline plug gage on an optical dividing machine.

investment running into hundreds of thousands of dollars.

Some of this manufacturing equipment is without equal anywhere in the country. In fact, experts who have inspected the plant have indicated that it is undoubtedly better balanced for comprehensive precision gage manufacture than any they have visited.

This new plant is equipped throughout with absolute air conditioning for temperature, dust and humidity control. The temperature is maintained constantly at 68 degrees Fahrenheit, with less than 2/10 of one degree variation. The humidity is controlled at 45 to 50 per cent, and dust content is controlled by two filter bank systems which remove the majority of dust particles. Ninety-nine per cent of the remaining particles are then removed by an electro-static precipitron, thus giving air as clean as the finest hospital room.

Testing equipment of this new plant includes two Pratt & Whitney standard measuring machines with three foot capacities, as well as three specially designed and constructed Kobe Measuring machines. Two of these Kobe units are for measurements up to 12 inches. The third measuring machine is one of the largest in the country. It is a finely constructed instrument used for measuring units up to fourteen feet in length. This Kobe unit has played an important part in the calibration of the gages required to produce the first 5-inch guns manufactured on the Pacific Coast. Dimensions of gages are also checked by light wave methods. Using optical flats which are true within one millionth of an inch, absolute accuracy is constantly maintained through every step of manufacture. This new plant also boasts of one of the only optical dividing heads on the Coast. This machine is used for controlling diametric and concentric accuracy. It divides a circle into a millionth part for absolute checking of dimensions.

The largest proportion of present day production is going for war needs, but the facilities of this modern plant will be available for West Coast industrialists. Even today, working with new materials, Kobe executives have devoted considerable thought to adaptation to peacetime needs. Testing, improving, retesting and perfecting—production efforts all aimed at what West Coast industry will need after the war. Gages of quality—in quantity—literally in our own backyard! A new industry is in full bloom—a welcome addition to the ever growing industrial garden of the West.

Conejo "Cat" Is Deepening

Sulphur Springs Oil Co. Janss No. 1, sec. 23-2n-19w, in the Conejo area of Ventura county is deepening at 4581 ft. after standing idle for a long period. When suspended at 4526 ft. in late 1940 the test was reported in the Vaqueros and present plans are reported to call for it to be carried to the 6000 ft. level.

A few of the different types of Kobe gages manufactured in Kobe's modern gage plant.

Field Development

Los Angeles Basin

Aliso Canyon Again Active

Tide Water Associated Oil Co. has again extended the known producing limits of the Aliso Canyon field by the completion of its Standard-Sesnon No. 2 in sec. 28-3n-16w, flowing an initial production of 1550 B/d from a depth of 8821 ft. East from this well locations are being prepared for Standard-Sesnon No. 3 and Porter No. 46. Approximately one mile to the west, in sec. 29-3n-16w, Standard Oil Co. has staked location for Del-Aliso No. 1 and is currently taking spot cores in Frew No. 1-1 at 4614 ft. In this same section Barnsdall Oil Co. and Bandini Pet. Co. have joined forces and staked location for Roosa No. 1.

Las Llajas Cat Plugged Back

Western Gulf Oil Co. successfully sidetracked the fish which was lost in its Brady Estate No. 1, sec. 13-3n-17w, and deepened to 9807 ft. Formations encountered were predominantly shale, so the lower portion of the hole was abandoned and it now is testing showings encountered between 3500 and 3575 ft.

Newhall Cat in Miocene

P. M. Girard is coring ahead in gray shale and gray sand at 6882 ft. in his Fisher-Wosk No. 1, sec. 6-3n-16w. Top of the Miocene was cored at approximately 6000 ft.

Norwalk Test Continuing

General Petroleum Corp. is prospecting ahead in its H. B. Allen No. 1 at 5970 ft., taking continuous ditch samples and coring at 50 ft. intervals. The well is located in sec. 12-3s-12w about one mile northwest from the town of Norwalk.

Puente Hills Well Cores Oil Sand

Horace Steele continues to core ahead in his Kenwood No. 1 at 3327 ft. Formation has been predominately hard brown shale below 3200 ft. where 6 ft. of oil sand was recovered from the cores. Hole is being put down in sec. 17-2s-10w southeast from the town of Puente. North of this well in sec. 4 Chas. E. McCartney has given up his Hurley No. 1 after two formation tests recovered only fresh water from sands which were cored between 3160 and 3259 ft.

Greenville Cat To Redrill

P. M. Girard is preparing to redrill and direct his Mark Fisher No. 1 to the east. Hole was bottomed in Basalt at 5655 ft. after coring 10 ft. of silty oil sand at 4600 ft. Test is located in sec. 27-5s-10w north of the town of Fairview in Orange county.

Newport Beach Gets New Test

Signal Oil and Gas Co. is preparing to spud its third try in this area. Well will be known as Banning No. 2 and is located in sec. 20-6s-10w about 900 ft. northwesterly from Banning No. 1, which is currently producing 15 to 20 barrels per day of clean oil. Operators other test in the area, Willows Comm. No. 1, was abandoned after drilling to 5006 ft. and finding only gray sand in the objective zone.

LOS ANGELES BASIN WILDCATS

Area	Well	No.	Section	Depth	Status
Aliso Canyon	Barnsdall-Bandini Pet. Co., Roosa	1	29, 3-16		Location
	Standard Oil Co., Frew	1-1	29, 3-16	4614	Drilling
	Standard Oil Co., Del-Aliso	1	29, 3-16		Location
Del Valle	Standard Oil Co., N.L. & F.	3-1	19, 4-17	5510	Drilling
Las Llajas	Western Gulf Oil Co., Brady	1	13, 3-17	9807	Testing
Montebello	Barnsdall Oil Co., Baldwin	1	11, 2-11	2983	Abandoned
Newhall	P. M. Girard, Fisher-Wosk	1	6, 3-16	6882	Drilling
Norwalk	Gen. Pet. Corp., H. B. Allen	1	12, 3-12	5970	Drilling
Puente	Horace Steele, Opr., Kenwood	1	17, 2-10	3327	Drilling
	J. C. Drilling Co., Kelso	1	12, 2-10	3194	Repairing
	V. & F. Oil Co., Grazide	1	27, 2-10		Location
Rice Canyon	General Pet. Corp., Mendota	1	22, 3-16	5691	Drilling
Temescal	The Texas Co., Dominguez	57-1	1, 4-18	6774	Drilling
Whittier-La Habra	H. & C. Oil Co., Joyce	1	22, 2-11	5825	Idle
	Orange County				
Greenville	P. M. Girard, Mark Fisher	1	27, 5-10	5655	Prep. to redrill
Newport Beach	Signal Oil & Gas Co., Banning	2	20, 6-10		Rigging up
	San Bernardino County				
Chino	Chino Hills Oil Co., Kraemer	1	33, 3-28		Location

Here Is the Story of LANE-WELLS "Steelflo" GUN PERFORATOR BULLET

And What It Means To You

Say 'OH-JIVE-AL'

The Lane-Wells "Steelflo" ogival-point bullet which provides greater penetration, cleaner perforations, better producing channels and more drainage area, is the latest result of years of intensive research into the problems of oil well gun perforation methods and results.

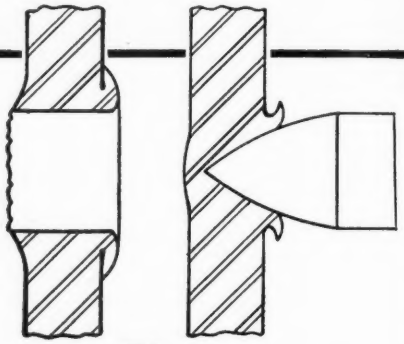
"Steelflo" is an exclusive Lane-Wells development that means a great deal to you as an oil well operator because it assures better and more uniform results on all types of Gun Perforator application. It utilizes the correct proportioning of the gun elements to better advantage. The design of the ogival-point (arch point shape) moves the center of gravity of the projectile forward and makes possible better flight stability.

DEEPER PENETRATION

The shape of the point makes it possible for the bullet to follow a straight path, through the casing and far out into the surrounding formation. The increased velocity sends the bullet farther out into the formation to achieve better producing channels and greater drainage area from each shot.

This new development has set higher standards for Gun Perforator operation and means that you can expect better results than ever before.

Your nearest Lane-Wells Field Branch can supply you with all the details of this new feature and explain how you benefit by "calling Lane-Wells."



The PERFORATION

The extreme point of the bullet is thicker and therefore stronger. Metal displacement of the casing at the time of perforating is more uniform. As a result the inside edges of the perforation are rolled back in a tightly flattened bead which reduces danger of damage to tools, swabs, packer or bridging plugs run in after perforating.

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El Segundo Test Looks Promising

Standard Oil Co.'s A. S. Gough No. 13, shallow gas test in the old El Segundo field, shows promise of being a substantial gas producer if operator is able to shut off the high head water which is present in this area. Hole is currently being drilled ahead at 4308 ft. but will probably be plugged back soon as no sands worthy of a test have been encountered below 3860 ft.

Huntington State Co. Abandons Deep Test

Huntington State Co.'s second well in the offshore pool was abandoned after drilling to 4828 ft. and finding only gray sand in both the Jones and Main sands. Hole was put down east of the known producing limits of the main zone and was considered something of a wildcat. Operator has now moved to the northeast corner of 19th and Ocean, where he will drill State No. 3 as a Jones sand well.

Northwesterly along Ocean Ave. Southwest Exploration Co. is placing State No. J-6 on production from the Jones sand, while Standard Oil Co. is rigging up on P. E. No. 27, the first of two straight hole Jones sand wells which will be drilled by this operator.

The Texas Co. Recovers Fish

Texas Co. Dominguez No. 57-1 after being held up for several weeks with fishing jobs has finally cleaned out the hole and is prospecting ahead in hard shale at 6774 ft. Try is located in sec. 1-4n-18w on the east end of the Temescal Anticline.

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Coastal District

Temescal Test Plugged Back

Pacific Western Oil Co.'s deep test Temescal No. 14 is plugging back and will test showings between 2570 and 2800 ft. Located in sec. 4-4n-18w at the east end of the Temescal field, hole was drilled and cored to a total depth of 10,313 ft. There were no showings found below the present producing horizons in the Temescal field.

Torrey Canyon Test Plugged

Union Oil Co.'s deep test of the old Torrey Canyon field is being plugged back and tested by stages after drilling to a total depth of 6146 ft. Bottomed in gray sand and shale, operator felt that insufficient showings had been found to justify the expense of fishing drill pipe which had stuck on bottom. Well is located in sec. 5-3n-18w.

Wiley Canyon Well Suspended

Wilshire Annex Oil Co.'s Ford No. 1 in sec. 1-3n-19w, Wiley Canyon district, was suspended after drilling into a fault zone at 626 ft. Operator intends to move the derrick about 600 ft. to the west to drill a new hole which will be known as Ventura Realty No. 1.

Pinole Area Gets Test

In the Pinole area of Contra Costa County the Standard Oil Co. has staked location for Oursan Community No. 1. Location falls in an unsectionized portion of the Rancho El Sobranto.

Richfield Moves to Glenn County

Richfield Oil Corp. is grading location for Afton Community No. 1-1 in the center of the n.w.¼ of sec. 2-18n-1w. North of this well in sec. 31-21n-1w Superior Oil Co. is spot coring ahead at 4590 in its Glenn Comm. Three No. 72-20.

Whittier Assoc. Tests Wildcat

Whittier Associates Barham No. 1, sec. 11-7n-32w in the East Purisima Hills area drilled to a total depth of 4847 ft., found nothing encouraging, and plugged back to 3362 ft. A combination string of 7 inch casing was run and cemented through perforations at 2632 ft. Operator is now cleaning out preparatory to making a production test.

Santa Rita Cat Starts

The Texas Co. spudded its Petan Investment Co. No. 1 on Sept. 9, 1943. Hole is now being drilled ahead below 1700 ft. in hard Cretaceous shale after setting 10¾ inch surface casing at 318 ft. Test is located in the Santa Rita Hills District on sec. 20-6n-32w about six miles west of the town of Buellton.

Amerada Completes Thornton Well

Amerada Pet. Corp. has completed another good gas well in Sacramento county. Hausken Community No. 1, sec. 28-5n-5e, was completed on Sept. 15, 1943, producing from gun perforation between 3285 and 3350 ft. for an initial production of 6852 M.C.F. of dry gas. Well is now standing shut in with pressures equalized at 1350 lbs. Well is reported to correlate approximately 70 ft. higher than the recently completed Capital Co. well in sec. 25.

COASTAL COUNTIES WILDCATS

Area	Well	No.	Section	Depth	Status
Casmalia	O. C. Field Gas. Corp., Casmite	2	13, 9-35	1900	Testing
Lompoc	Alphonzo E. Bell Corp., Lompoc	7	28, 8-34	4516	Suspended
Los Olivos	Hub Oil Co., La Laguna	1	7, 7-30	2750	Drilling
Purisima Hills	Whittier Assoc., Barham	1	11, 7-32	4847	Testing
Santa Rosa	The Texas Co., Petan Inv.	1	20, 6-32	1660	Drilling
Tinaquaic	Union Oil Co., Sisquoc C. H.	3	28, 9-31	2640	Abandoned
	Union Oil Co., Sisquoc C. H.	5	18, 9-31	450	Drilling
	Ventura County				
Bardsdale	Camarillo Oil Co., Camarillo	2	32, 2-20	1207	Drilling
Conejo	Allied Ppty, Inc., Camarillo	2	4, 1-20	148	Idle
	Sulphur Springs Oil Co., Janss	1	23, 2-19	4581	Drilling
Del Valle	Herley-Kelley, Black	1	13, 4-18		Grade
Eureka Canyon	El Rika Oil Co., Well	5	33, 4-18	432	Drilling
Fillmore	Standard O. Co., Fillmore Comm.	2-1	24, 4-20	7484	Drilling
Happy Camp	Cal Camp Oil Corp., Harrington	1	21, 3-19		Location
Ojai	Richfield Oil Corp., Ojai	48	12, 4-22		Grade
Oxnard	Edward F. Delaney Todd	1	6, 1-21		Location
Piru	Pac. West. O. Corp., Temescal	14	4, 4-18	10313	Testing
	Standard Oil Co., Crestmont	1	14, 4-18	6831	Drilling
Sespe	Volunteer Pet. Co., Tar Creek	3	28, 5-19	1040	Drilling
South Mt.	F. E. Fairfield, S. M.	1	19, 3-20	3911	Drilling
Torrey Canyon	Union Oil Co., Torrey	60	5, 3-18	6146	Stdg. cemented
Wiley Canyon	Wilshire Oil Co., Ford	1	1, 3-19	626	Suspended
	Ventura Realty	1	1, 3-19		Location

NORTHERN COUNTIES WILDCATS

County	Well	No.	Section	Depth	Status
Butte	Richfield Oil Corp., Chico	1	17, 21n-1e	3876	Drilling
Contra Costa	Cal-Bay Corp., Faria	1	21, 2n-1w	3697	Idle
Glenn	Superior Oil Co., Glenn Com. Three	72-20	31, 21n-1w	4590	Drilling
Monterey	Royalty Service Corp., Federal	1	21, 24s-10e	5280	Drilling
Sacramento	Amerada Pet. Corp., Hausken Comm.	1	28, 5n-5e	6003	Completing
San Joaquin	Amerada Pet. Corp., Thompson & Folger	1	3, 4n-6e		Rigging up
	Standard Oil Co., Holt Comm.	1	15, 1n-5e	5319	Abandoned
	Standard Oil Co., Fairoaks Comm.	1	19, 1n-7e		Grading
	Standard Oil Co., No. Roberts Isl.	1	36, 1n-5e		Rigging up
Solano	Standard Oil Co., Honker Comm.	1A	25, 3n-1w	7435	Drilling
	Standard Oil Co., A. O. Stewart	1	25, 3n-1w	5693	Drilling
	Standard Oil Co., Fontana Farms	1	23, 3n-1w		Rigging up
	Standard Oil Co., Suisun Comm.	3	5, 3n-1w		Location
	The Texas Co., Stewart	74-7	7, 4n-1e	4182	Conv. to water well
Yolo	Empire O. & G. Corp., Porterfield	1	Ro. Capay		Location
	Shell Oil Co., Inc., Glide	1	15, 7n-3e	5804	Prep. to test
	The Texas Co., Winchester Six	1	20, 7n-4e	2270	Drilling

Two On Pump At Santa Maria

Union Oil Co.'s consistent development of its Santa Maria Valley holdings is equally steadily being rewarded. Latest in were Adam No. 4 and Battles No. 6 for an average 125 bbls. daily each. Drilling for the heavy gravity crude so badly needed today continues with two strings constantly at work on a long range program. Other operators with yet undrilled inside acreage are expected to start drilling soon.

At the south flank of the field Bel-Air Oil Co. has received permission to redrill the once abandoned Ray W. Wilson Beaufoy No. 1 in sec. 26-10n-34w. The redrill will be called Twichell-Weging Comm. No. 2 since the current well adjoins the company's lease carrying this name.

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4-90-200-lb. Boilers and other Drilling Equipment. Cash or Terms. B. A. Coates. Phone Long Beach, 51120 before 10 a.m.

Standard Tests Fillmore Cat

Northwest of the town of Fillmore Standard Oil Co. is preparing to test showing in its Fillmore Comm. No. 2-1. Hole has been drilled and cored to the present depth of 7484 ft., where showings sufficient to warrant the running of a formation test were encountered. Operator has released no information relative to the age or kind of formation being tested.

Lompoc Well Pumping Tar

Alphonzo E. Bell Corp. Lompoc No. 6, sec. 28-8n-34w, is pumping from 4905 ft. and injects 20 gravity crude to cut the 5 gravity formation oil. This producer is making an average 125 bbls. daily net recovery by employing 4¾ in. tubing and one of the world's heaviest oil field pumps, an outfit which operates on a 108 in. stroke. The company has suspended its adjacent No. 7 at 4516 ft. after sticking drill pipe in a fault zone in the open hole and has moved the drilling rig to the Bel-Air Oil Co. Donovan No. 1 which is preparing to spud on sec. 13-10n-35w in the Santa Maria Valley.

Tide Water Gets A-2 Zone Well

Tide Water Assoc. Oil Co. gun perforated its Lloyd No. 44 in the A-2 zone at Ventura Avenue and recompleted flowing a maximum 204 bbls. of 30.2 gravity oil and 977,000 cu. ft. of gas through a 40/64 in. bean. This is the first new production in this zone since General Petroleum Corp. made a surprise discovery of its productivity in midsummer of this year. Tide Water is running four strings in this field on a consistent development program while Shell Oil Co., Inc., employs a similar number of drilling rigs. Gen. Pet. Corp. runs two strings and Lloyd Corp., Ltd., and British American Oil Prod. Co. utilize one string each.

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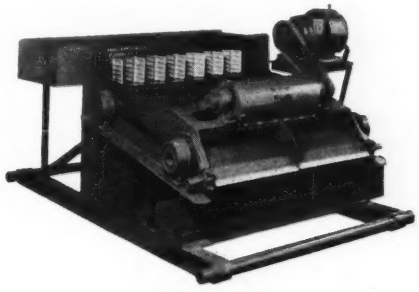

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San Joaquin Valley

Shafter Area Gets New Test

Approximately 2½ miles west from the town of Shafter, Tide Water Associated Oil Co. has staked location for Schnaidt No. 86-7 near the east ¼ corner of sec. 7-28s-25e. Operator reports it will be a deep test.

Madera Well Looks Promising

In the Firebaugh area of Madera county The Texas Co.'s Moffatt No. 1-7, sec. 7-12s-15e, shows indications of being a very substantial gas producer. On test of a 15 ft. interval at 3953 ft. the well blew in in excess of 7,000 M.C.F. per day of dry gas. Operator has now shot additional holes up to 3920 ft. and is preparing to place well on production.

Victory Oil Co. To Drill McKittrick

Victory Oil Co. has let the contract to Fowler Drilling Co. for eight wells to be drilled in sec. 26-29s-21e. Locations are being graded and contractor will move in as soon as they are ready.

Valley Work Remains Brisk

Drilling activity in the San Joaquin Valley remains active where inside drilling locations are yet available. Most intensively at work are Midway-Sunset, South Belridge, Coalinga, Round Mountain, Kern Front and Poso Creek. Work also remains active in the Riverdale field, where Amerada Pet. Corp. has a long term development program under way. Wildcatting, of course, remains at a high level as can be seen by the projects currently carried on the tables in this issue. Remedial work which can be done with out great expenditures of material are constantly being undertaken in all fields and it is thought highly probable that owing to a heavy oil demand this phase of development will be greatly augmented.

Raisin City Well Shows Gas

Shell Oil Co. San Joaquin No. 1-1, northwest of the Raisin City Field in sec. 10-15s-17e, is currently being drilled ahead in gray sand and shale at 5150 ft. A formation test was made of the interval 4973-5035 ft. which, open for 17 minutes, blew wet gas with a spray of salt water in excess of 22,000 M.C.F. per day. Tentative correlations place this zone approximately 15 ft. lower than the same zone in the recently completed Seaboard Oil Co.'s S.T.U. No. 53 in sec. 14-15s-17e.

Lytle Completes Guijarral Well

In the Guijarral Hills area of Fresno county R. S. Lytle has completed his well No. 86-20F on sec. 20-20s-16e. Initial production was gauged at 900 bbls. per day of 29 gravity oil. Hole was bottomed in silt at 9012 ft. and is producing from 220 ft. of perforations between the depths of 8919 and 9012. Operator has moved to the south and is rigging up on well No. 3-28F in sec. 28-20s-16e. In this same section Standard Oil Co. is preparing to drill P.V.F. No. 1-28F.

SAN JOAQUIN VALLEY WILDCATS

Area	Well	No.	Section	Depth	Status
	Fresno County				
Cantua Creek	Seaboard-Pure Oil Co., Corehole	1	28, 17-14	947	Drilling
Curry Hills	Standard Oil Co., Camino	2-1	31, 21-15	3640	Abandoned
Huron	Gen. Pet. Corp., Burrel	1	2, 17-18	9400	Abandoned
	Gen. Pet. Corp., Burrel	68-35	35, 16-18		Rigging up
Jacalitos	Standard Oil Co., Well	67-17E	17, 21-15		Rig
	Standard Oil Co., Wells Fargo	1	30, 21-15		Location
Lanare	Amerada Pet. Corp., Cal. Lds.	65-15	15, 17-18		Cellar
Nicholson	Shell Oil Co., Inc., S.P.	73-35	35, 15-15		Foundation
Polvadero	Standard Oil Co., Bourdieu	1	1, 21-16	4108	Abandoned
	Standard Oil Co., Bourdieu	1A	1, 21-16		Rigging up
Raisin City	Seaboard Oil Corp., STU	31-14	14, 15-17	593	Drilling
	Shell Oil Co., Inc., San Joaquin	1-1	10, 15-17	5151	Drilling
	Univ. Consol. Oil Co., Taylor	1	14, 15-17		Rigging up
	Kern County				
Belridge—South	C.C.M.O. Co., Temblor	36-1	36, 28-20		Location
	Kohlbush & Lyons, U. S.	1	6, 29-22		Prep. to spud
Comanche Point	T. W. Burnham, Chiquita	2	34, 12-19	2137	Drilling
Edison	Tracy Harkness Seale	2	5, 30-29		Rig
	J. Paul Getty, Portals	3	5, 30-29		Rigging up
Elk Hills	Pacific Western and G. F. Getty, Transport	64	26, 30-24	745	Drilling
Fellows	C.C.M.O. Co., Well	11-7	7, 32-23	3015	Completed
	C.C.M.O. Co., Well	12-7	7, 32-23		Rigging up
Fruitvale	T.W.A. Oil Co., KCL	54-6	6, 29-27		Rigging up
Grapevine	Kern Line Oil Co., Well	1	19, 11-19	8701	Drilling
Jasmine	Barnhart-Morrow Cons., B. M. Quinn	1	15, 25-27		Grade
	Western Gulf Oil Co., Well	1	4, 25-27		Location
Lost Hills	Union Oil Co., Ellis	8-11	11, 27-21	2003	Drilling
McClung	Continental Oil Co., KCL	G-1	4, 30-26	8135	Completed
	Superior Oil Co., KCL	12	3, 30-26	13131	Testing
Midway	C.C.M.O. Co., Well	G-1	20, 31-22	1827	Drilling
Mt. Poso	Da-Me Oil Co., Well	3	27, 26-28		Rigging up
	K. F. Gill Young	1	30, 27-28	1800	Drilling
Poso Creek	Butler Bros. Oil Co., Butler	1	14, 27-27		Rig
	Grandell Oil Co., Claflin	5	10, 27-27	1284	Completing
	Golden Bear Oil Co., Agey	4	28, 27-27	2058	Completing
	Pac. West'n O. Corp., Enas Fee	27A	21, 27-27	2084	Completed
Round Mt.	Bandini Pet. Corp., Signal-Mills	1	24, 28-28	2435	Completed
	Gen. Pet. Corp., Railroad	2	23, 28-28		Location
Shafter	Tide Water A. O. Co., Schnaidt	86-7	7, 28-25		Location
Strand—East	T.W.A. Oil Co., KCL	54-8	8, 30-26	7299	Drilling
Tehachapi	E. G. Cummings, Poor Boy	1	31, 32-32	1215	Idle
Temblor	B. F. Delanty, Well	69-A-1	36, 29-20	70	Idle
	Kings County				
Hanford	Seaboard Oil Corp., Phillips	66-2	2, 19-22		Location
Pyramid Hills	Pac. O. & G. Dev. Corp., CC&MO	1	17, 24-18	962	Idle
	Pac. O. & G. Dev. Corp., CC&MO	2	20, 24-18	935	Idle
	Madera County				
Herminghaus	The Texas Co., Gill	71-21	21, 13-16	4361	Drilling
Firebaugh	The Texas Co., Moffat	1-7	7, 12-15	4308	Completing
	Tulare County				
Porterville	T.W.A. Oil Co., Corehole	84-35	35, 21-26	2333	Abandoned
	T.W.A. Oil Co., Corehole	87-11	11, 22-26		Rigging up

Continental Completes McClung Test

Approximately two miles northeast of the Strand field, in sec. 4-30s-26e, Continental Oil Co. has placed K.C.L. No. G-1 on production for an initial production of 261 bbls. per day of 29 gravity oil. Well is producing from 13 ft. of gun perforations above the plug at 7501 ft.

East of this well, in sec. 3-30s-26e, the Superior Oil Co. is cleaning out and testing by stages its abandoned K.C.L. No. 12. This well was originally drilled in 1939 to a depth of 13, 131 ft. and abandoned after several tests below 11,000 ft. recovered all salt water.

Bandini Completes Extension Test

Bandini Pet. Corp. has discovered a new producing area in what is thought to be another fault block west of the Round Mountain field. Signal-Mills No. 1, in sec. 24-28s-28e, was completed on the pump Sept. 15, 1943, for an estimated initial production of 250 bbls. per day of 17 deg. gravity oil cutting 10 per cent fresh water and mud. Well is producing from 22 ft. of zone between the depths of 2413 and 2435 ft. West of this well, on sec. 23, General Petroleum is preparing to drill Railroad No. 2 in search of a similar accumulation.

Richfield Try Rigs Pump

Spitfire Oil Co.'s Richfield well Davenport No. 3 on sec. 28-3s-9w, is rigging pump after swabbing water from the interval 4130-60 ft. This old-timer was deepened to a barren 5803 ft. and plugged for casing and gun perforation trial of sand zones encountered.

At the extreme easterly flank of the field Standard Oil Co.'s Anaheim Union Water Co. No. 2-1 was completed at 3590 ft. flowing 177 bbls. in 22 hrs. 15.9 gravity oil cutting 24.0% thru a 16/64" bean and 120,000 cu. ft. of gas.

Union Oil Co. has not yet started its projected Chapman No. 47 on the field discovery lease in sec. 29-3s-9w.

Poso Area Gets Boom

On the strength of the good production which Pacific Western Oil Corp. effected on the Enas Fee property at North Poso Creek, much work is scheduled for the area. The discovery company is completing its third well in the area, while Grandell Oil Co. and Golden Bear Oil Co. are each operating one string. Standard Oil Co. has filed proposals to work and much additional activity is under discussion.

Grapevine Well Quits

Richfield Oil Corp. abandoned its latest search for oil in the Tejon area in the Southerly San Joaquin Valley. Bottomed in gray sand at 5625 ft. the well, Tejon No. 4 on sec. 34-11n-19w, found many sand sections none of which contained oil. The company, holder of thousands of south valley leased acres, is contemplating another test in the near future.

To the north, on section 19, Kern Line Oil Co.'s old 8390 ft. well No. 1 is deepening in hard shale at 8701 ft.

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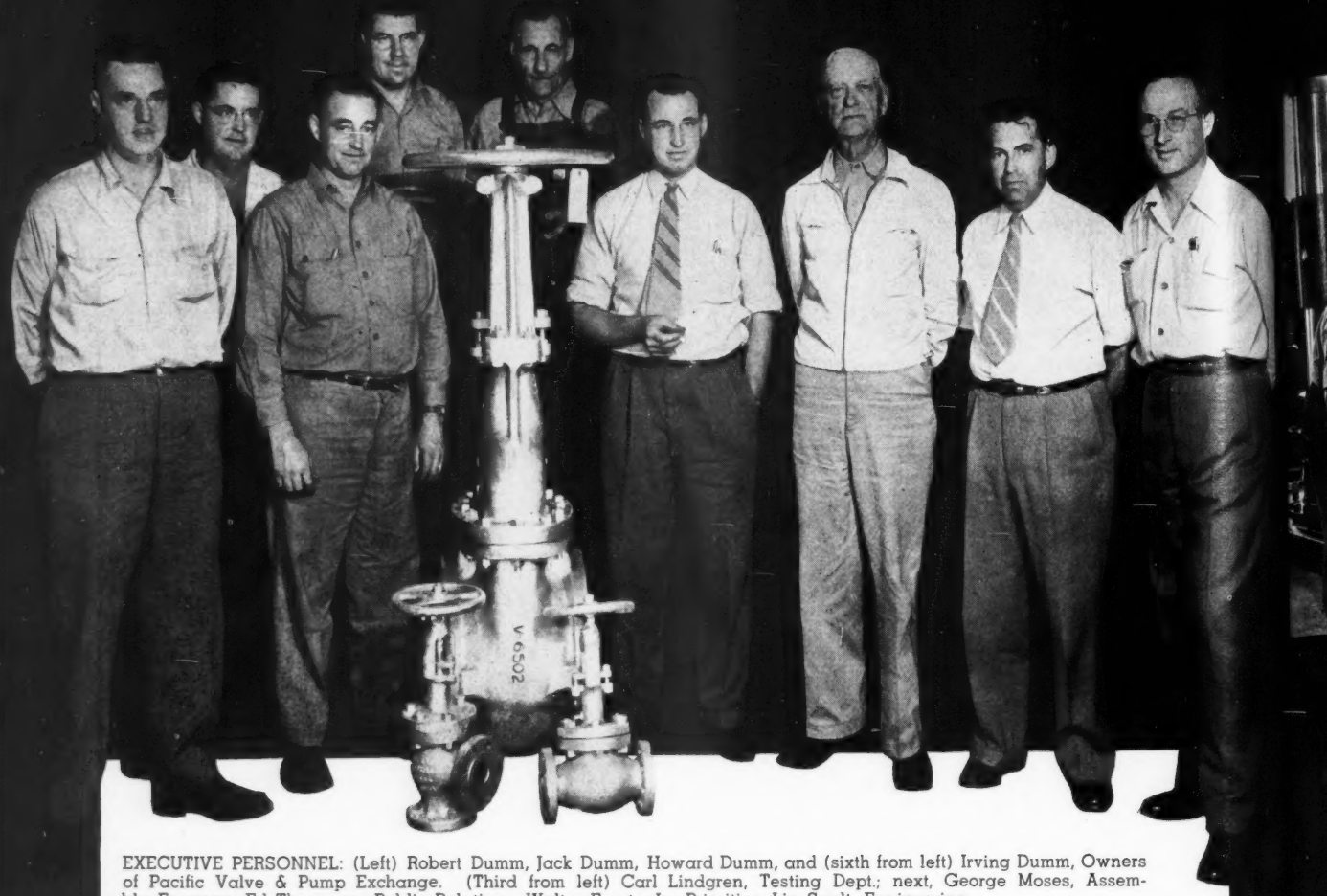
Shell To Test Dixon Wildcat

Shell Oil Co., Inc., is preparing to test its Glide No. 1 on sec. 15-7n-3e in the Dixon area of Yolo county. Bottomed in Cretaceous sand at 5804 ft. after taking a reported 1200 ft. of zone, the well remains a question to observers since no indication of the worth of sands encountered has yet been released by the company.

Oil Workers are War Workers.



EXECUTIVE PERSONNEL: (Left) Robert Dumm, Jack Dumm, Howard Dumm, and (sixth from left) Irving Dumm, Owners of Pacific Valve & Pump Exchange. (Third from left) Carl Lindgren, Testing Dept.; next, George Moses, Assembly Foreman; Ed Thompson, Public Relations, Walter Everts, Jr., Priorities, Lin Sault, Engineering.

SHIPS ARE MADE OF MANY THINGS

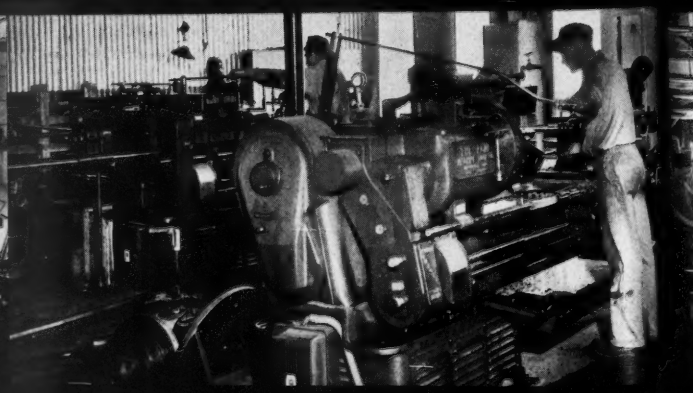
When, in December, 1941, our valued peace came to an abrupt end, one truth—one indisputable fact—became obvious, ships and yet more ships were needed to transport the men and goods to our fighting fronts in addition to those of our gallant Allies which we had been supplying.

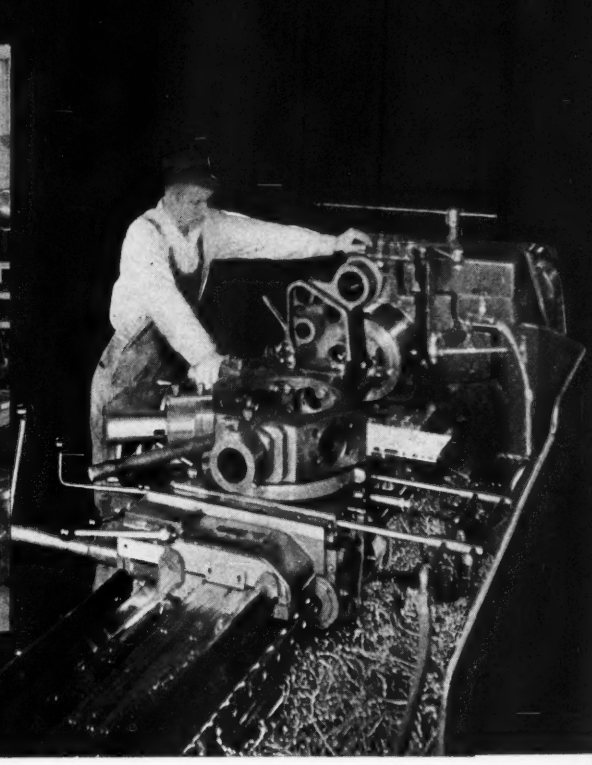
With West Coast shipyards already doing a gigantic job of building their immediate programs called for tremendous expansion, both in shipways and output on existing ways.

Now there is more than hull and engine to a modern ship, and as these prime requisites came on in greater number so the demand grew for more and more of the vital sundries which bring life to the complex being landmen know as ships.

High in the ranks of these valuable adjuncts to shipbuilding are valves, small and large, to control fuel, water, ballast, steam and in some cases cargo. Valves built to precision and of specific strength, for wartime exigencies do not tolerate failure.

To the production of these wartime valves were turned the resources of many industries and high among West Coast plants was Pacific Valve & Pump Exchange of Signal Hill—for who should be better able to build them than





men who knew through long experience in the oil industry the problems entailed.

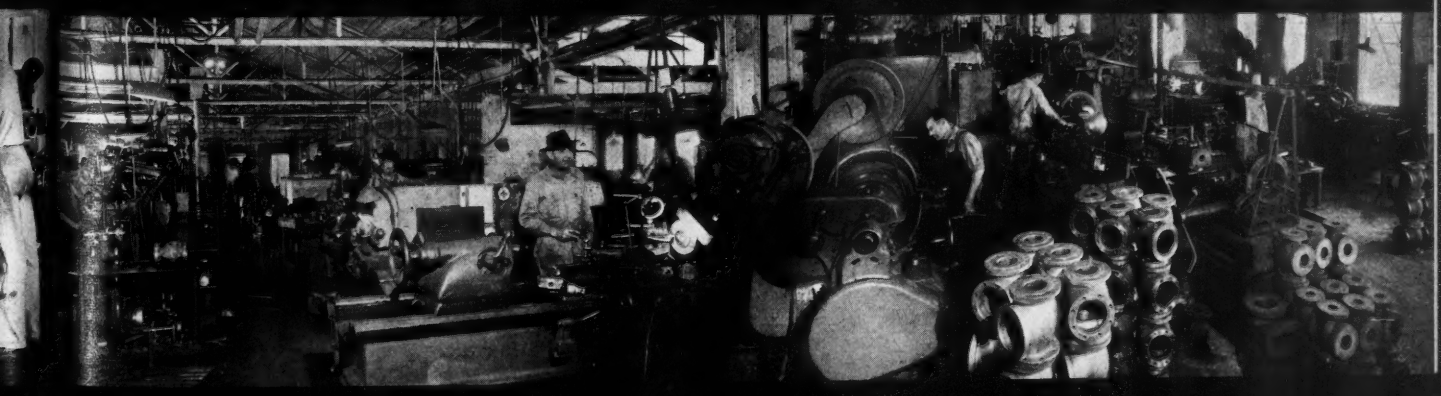
Accordingly, the principals of Pacific Valve and Pump Exchange, the four well known Dumm brothers, Howard, Irving, Jack and Robert, called in their co-workers Walt Everts, and C. L. Sault. With administration and production in the hands of the Dumm Bros., procurement and priority vested in Everts, design engineering in Sault, and E. O. Thompson in charge of public relations, this aggregation has made production history.

Starting from a small Cherry Avenue shop this firm has attained prime contractor status with a valve production volume which, although secret by government order, is conceded by all to be phenomenal.

Rebuilt in the face of extreme adversity, this plant acquired nearly priceless machine tools, expanded building facilities, designed, moulded, cast, machined and delivered many, many valves before those who knew the steps required thought it possible. What they did not know was the tremendous drive of a well developed team working to a common end. Pacific Valve and Pump Exchange had that driving force.

Smoothly functioning with an extremely high production figure, whether calculated in units, or tonnage, this company now makes some 29 types of valves and adaptions thereof for the Maritime Commission. Almost without exception the plant is devoted to the production of goods for war but has found time, largely long after most of us have gone to rest, to produce special equipment for critical industrial needs.

Pacific Valve and Pump Exchange is working at war for the sake of peace—a peace which will permit the placing of its modern plant facilities, skilled personnel, know-how and thoroughness again at the disposal of the California oil man—be he producer, refiner or pipeliner.



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Pacific Gear and Tool Works San Francisco Plant Wins "E" Award

At colorful and impressive ceremonies held at their San Francisco plant on July 31st, 1943, the Pacific Gear & Tool Works was awarded the coveted Army-Navy "E" for outstanding achievement in the production of war material. This is the second of the Bannan companies on the Pacific Coast to receive this award.

Captain Alva B. Court, Inspector of Naval Material, in making the presentation in behalf of Secretary of the Navy, Frank Knox, told the workers of the vital part the gears they made were playing in our underseas and surface vessels and aircraft all over the world. In accepting the "E" Burgee, Philip L. Bannan, President of the pioneer San Francisco firm, stated that he "fully realized the responsibility which this commendation carried with it," and he in turn "charged each employee with the trust and duty they had now assumed." Peter Lo Codo accepted the "E" pins in behalf of all his fellow workers from Lt. Col. A. J. Stevens, Adjutant to the District Chief, San Francisco Ordnance District.

A rather unusual innovation to the ceremony was the presence of a mixed color guard consisting of two United States Marines and two women Marine Corps Reserves, who served as guard of honor at the raising of the national emblem.

C. Harold Caulfield, prominent San Francisco attorney and former President of the San Francisco Board of Education, acted as Chairman of the program. The four sons of Mr. Bannan, who are now managing the Seattle plants of Western Gear Works and the two plants located in Southern California, respectively, were present on this eventful occasion.

Many high-ranking Army and Navy officials in addition to quite a number of prominent civic and industrial leaders from the Bay area were in attendance as honored guests. Preceding the ceremony the company sponsored a noon-time luncheon for the employees and their families.

The United States Coast Guard Band, consisting of thirty pieces under the direction of Bandmaster Leonard Hickson, U.S.C.G., furnished the music for this affair.